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SILVICAL REPORT

HUMBOLDT NATIONAL FOREST

NEVADA

By

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The Forest.

The Trees.

Pinus flexilis, Limber Pine, White Pine, Bull Pine, Pine.

Pinus albicaulis, White Bark pine, common names as
above.

Pinus monophylla, Single Leaf Pine, Pinyon, Nut Pine,
Scrub Pine.

Abies lasiocarpa, Alpine Fir, Spruce Pine, Spruce
Fir, Balsam Fir, Balsam, Fir.

Juniperus scopulorum, Rocky Mountain Juniper, Juniper,
Cedar.

Juniperus communis, Dwarf Juniper, Juniper, Cedar.

Salix nuttalli, Nuttall's Willow, Willow.

Salix amygdaloides, Almond Leaf Willow, Willow.

Populus tremuloides, Quaking Aspen, Quaking Asp or
Ash, Aspin, Cottonwood.

Populus balsamifera, Balm of Gilead, Balsam, Balsam Poplar,
Cottonwood.

Populus angustifolia, Narrow Leaf Cottonwood, Cotton-
wood, Poplar, Willow Poplar.

Alnus tenuifolia, Mountain Alder, Alder.

Cercocarpus ledifolius, Curl Leaf Mahogany, Mahogany.

Amelanchier alnifolia, Western Service Berry, Sarvis,
Sarvis Brush.

Prunus demissa, Western Choke Cherry, Cherry.
Sorbus scopulina, Mountain Ash, Wax Berry.
Sambucus glauca, Blue Elderberry, Elder.
Acer glabrum, Dwarf Maple, Vine Maple, Mountain Maple.

THE SHRUBS; arranged roughly accoring to altitude, the
first named occurring lowest.

Chrysothamnus-species, Rabbit Brush, Greasewood.
Artemisia-species, Sage Brush, Black Sage, Silver Sage.
Cornus stolonifera, Red Dogwood, Kinnikinnik.
Jamesia americana, Hydrangea.
Ribes setosum, Spiney Currant, Currant, Gooseberry.
Oreobatus deliciosus, Thimble Berry.
Purshia tridentata, Bitter Brush, Buck Brush, Greasewood.
Symphoricarpus glaucus, Snow Berry.
Ceanothus velutinus, Snow Brush, Deer Brush, Laurel.

THE TYPES.

- A. Grazing.
 - 1. Sage Brush.
 - 2. Grass.
- B. Wooded.
 - 3. Juniper Pinon.
 - 4. Mahogany.
 - 5. Aspen.
 - 6. Alpine.
 - (a) Open sub-type.
 - (b) Dense sub-type.

Types 1 and 2.

While the grazing types, of course, have no silvical characteristics, their limiting factors should be discussed in order to show their relation to the true forest types.

All of the factors that give rise to the grazing types, grass and sage, are not well understood. However, differences in soil and air moisture exert the principal influence in determining the cover of practically all of our land and, while there are many seeming exceptions, it is safe to state for these types, that the moister places are occupied by grass, while the drier places, especially where the snow does not become deep, are taken by sage brush. As one approaches the divide between the Great Basin drainage and the Snake River drainage, from the south, the sage becomes less and less important and the grass occupies most of the area adjacent to the divide. However, continuing across the divide and down to the "Snake River Desert", one finds that the sage brush again becomes the predominant growth although the grass extends to considerably lower elevations on that side and the sage brush is heavier than in the Basin. Within the broad outlines of the grass type, one finds many sage brush areas, including entire stream basins, steep canyons sides and even mountain slopes up to elevations of nearly 9,500 feet. Sage brush

avoids places where the snow lies for a long time and for this reason the smoother places in the high lands are taken by grass, while the rough steep slopes, especially those facing the sun, have sage. Sage brush is found both above and below the grass and sometimes the two mingle in equal proportions on steep ridges, the grass occupying the shallow draws while the sage brush covers the little ridges between the depressions. Both types cover many varieties of soil and it is not likely that the soil is a factor in limiting either type. The granite formation of the Bruneau Division gives rise to topographic conditions that are more favorable to grass than to sage while the basaltic formations supply places topographically suited to sage brush, but I doubt the possibility of establishing any close connection between the character of the soil and the distribution of these types. Grass is excluded from the moisture parts of the grass type by aspen and brush and by the lower reaches of the alpine type.

Type 3.

This is the familiar juniper-pinon type of the Great Basin. It is limited to the southern and eastern lower slopes of the Ruby Mountains. The type does not invade the rougher areas or places where there is considerable moisture. Juniper is confined

almost entirely to the limestone formation (Boundaries Report, Ruby Mountains.) and does not often occur above 7500 feet.

TYPE 4.

Mahogany occurs on rough, dry and much exposed rocky knobs and extends into dry, rugged basins like that of Telephone Creek in the Bruneau Division. The type is somewhat more prevalent on southern than on northern exposures, perhaps because the grass on the northern slopes prevents reproduction of the mahogany. Mahogany seldom occurs above an altitude of 7,000 feet. Granite and limestone formations furnish the principal areas altho equally good stands of smaller extent are found on the andesite buttes near Jarbidge. The type is undoubtedly limited by the grazing industry although it is evident that much greater factors are present because the type was strictly limited before the grazing became of importance. It seems that mahogany can thrive only on places that are not favorable to other types, although saplings are occasionally found on good situations with young aspen.

TYPE 5.

The aspen type includes the narrow stream bottoms and the moister slopes at moderate elevations.

Large areas on the Bruneau Division are occupied by irregular stands of aspen but on the Ruby Mountains the type is more strictly limited because of the scanty moisture supply. Belts of aspen brush, greatly stunted, are found on steep slopes below places where the snow stays longest. The type is most prevalent on northerly exposures at altitudes ranging around 6,500 feet. Aspen follows many of the streams out of the Forest, one of them at an elevation of 5,000 feet, but does not extend above 9,500 feet and the average altitude limit is about 8,000 feet. No preference as to soil has been observed. The type thrives wherever there is sufficient moisture without too much exposure to cold winds.

TYPE 6.

The alpine type occurs on the higher mountain tops throughout the Forest. All through the region the trees of this type occupy isolated peaks and mountains. This fact seems to point to the possibility that the climate at one time was much more favorable to tree growth than it is at present, else, how did this wide distribution come about? However, there is no evidence of any other species ever having grown on the Humboldt. It may be that an ice sheet destroyed all

of the trees except those that could live on the mountain tops or perhaps the ice played an important part in the primary distribution of the trees. It seems improbable that the birds may be credited with such a wide movement. The type occurs between altitudes of 7,500' and 10,500', although it is not now found at the lower elevation except in a few canyon bottoms. The average elevation is between eight and ten thousand feet. Northerly exposures are most prominent in this type although all exposures at high altitudes are freely occupied. The absence of the heated air found lower down doubtless favors this coniferous type and the snowdrifts supply plenty of moisture. The type is not affected by differences in soil quality or composition. The trees grow wherever there is enough soil of any kind at all combined with a sufficient water supply. The type is subdivided according to density and this division is always dependent on the balance between the moisture supply and the drying influences exerted at the different sites.

SILVICAL CHARACTERISTICS, by Types.

TYPE 3.

The Juniper-pinon type occupies about two percent of the total area of the Forest.

It is always distinguished by the presence of the sprawling Utah juniper and often by groups of short, heavy-branched, single-leaf pine. There has been no opportunity for anything more than the most casual study of this type on the Humboldt but the species are probably represented at present in the ratio of eight junipers to one pine because the pine was more valuable for fuel and charcoal, more easily cut and has much less reproductive power than the juniper. The juniper has been extensively cut for posts and for fuel but some low branches are almost always left. These branches are able to provide for reproduction. All ages are represented in most cases although the mature trees are much in the majority in virgin stands.

The type is frequently associated with sage brush and there is often sparse bunch grass and scattered lupine. The ground is usually almost devoid of humus. The conditions necessary for reproduction are not definitely known but the species included are often found under conditions that would seem to be altogether unfavorable, - for instance, on dry, gravelly slopes or even in crevices in the rocks. The pine, however, appreciates a damp, moist soil such as one finds in the canyons. In such places pinon pine sap-

lings are fairly tolerant, growing under aspen poles. Heavy cutting or fire tends to increase the proportion of sage brush but the type is well able to hold its own in the long run because it occupies situations that are not favorable to any other tree growth, and the sage brush doubtless helps the juniper and pine by shading the ground enough to conserve the moisture for the seedlings.

The uncertainty of reproduction of the one-leaf pine calls for conservative cutting. In most cases not more than one-third of the stand should be removed and the brush should be lopped and scattered for protection to the seedlings. The juniper, in many cases, might be cut by taking out the heavy limbs and leaving one erect, central branch or the main stem in older trees for reproduction, protection and for provision for a future cutting.

TYPE 4.

The mahogany type includes about three percent of the total area of the Forest.

The permanent distinctive characteristic is the presence of Cercocarpus ledifolius which nearly always occurs unaccompanied by any other tree species, although young aspen and young mahogany are sometimes associated on moist, fertile places. All ages are

represented but the middle aged to mature trees are by far the most prominent except where there have been recent cuttings. The mahogany type furnishes a large amount of grass and weeds suitable for sheep feed and the grasses left by the sheep are attractive to cattle in the late autumn because the type is ^{usually} open to the sun and the snow is shallow here when it is deep on the grass land. The humus is very light or entirely lacking except in rocky places where the wind blows the vegetable matter into sheltered spots. Here the decomposition is slow. Mahogany reproduces well on most places that are open to the sun and not too heavily covered by grass. As in case of the juniper-pinon type, sage brush and grass are the only encroaching types because the mahogany areas are altogether unsuited for other growth. Sage brush and grass may come in temporarily after heavy cuttings but the mahogany is able gradually to crowd out the sage brush and the sparse stands of grass.

Little can be done in the way of silviculture in the case of mahogany. Its protective functions should always be remembered and cutting should be confined to the old trees in the denser stands. As in the case of the low branching juniper,

one erect central stem or branch might well be left in order that the strongly developed root systems of the large trees may still be utilized instead of being allowed to die for lack of above-ground parts.

TYPE 5.

The aspen type includes approximately fifteen percent of the total area of the Forest.

Its permanent distinguishing characteristic is the presence of the trembling aspen. In the lower canyon bottoms Balm of Gilead, narrow-leaved poplar, and Rocky Mountain juniper are present in unimportant quantities, and here the aspen shows the greater range in age, all classes being present with the large poles predominant. On the steep snow-bound slopes the trees are all of about the same size but their age cannot be determined without ring counts because the adverse conditions hold back the older trees more than the young ones and tend to produce uniformity among the trees of ^a ~~the~~ site.

The ground cover in better situations consists of heavy weeds and grass with light service berry, rose brush, currant and other shrubs. However, sheep grazing keeps down the ground cover and prevents the formation of normal humus. In the poorer situations the late lying snow prevents the growth

of any important ground cover and the leaves are often all blown away. The humus is, therefore, light in many places although it is sometimes two inches thick in places that are protected from the wind.

Reproduction is vigorous on moister places all through the type although the Populus species cannot grow under shade.

Fire, in the past, has killed some aspen stands, (Tennessee Creek and elsewhere.) and they have been succeeded by Ceanothus velutinus. Now, however, the ceanothus is dying or dead under the aspen which is recapturing the areas. Frequently small patches of sage brush are included within the aspen but the reason is found in conditions that are unfavorable to the aspen, for sage brush never really encroaches on the true aspen land unless an exception be made for burns. Sage brush and grass might follow fire but they would certainly not be able to hold their position long if the aspen had a chance to seed over the burned area.

The sprouting ability of aspen and the strong seed production make silvicultural management comparatively easy. In some cases grazing animals have stripped the young seedlings and sprouts. This damage is not of great importance in dense pole stands but

the sheep should be excluded from open stands and, especially from cutting areas, if the highest silvicultural results are to be attained. Economic conditions are such that practically all cutting must be on the selection system. There is no considerable market except for firewood, and other materials used by the widely scattered ranchers. Of course the dead wood should be utilized first but in many localities this is scarce or already exhausted. Again the roughness of the country and the long distances between some of the areas and points of use preclude any cutting at present. The ideal system of management would be coppice with standards but the only practical method is to gradually improve the type by taking out the inferior and over-mature trees, providing for all-aged stands that shall furnish all classes of material without over-cutting. The demand for wood is so light in most parts of the Bruneau Division that the slow improvement of the type by selection is not accompanied by difficulties.

TYPE 6.

The alpine type includes approximately three percent of the total area of the Forest.

The type is distinguished by the presence of the typical alpine species, -viz., limber and white-

bark pines and alpine fir. At the lower elevations the fir is predominant but on the high, unsheltered places, the fir is unable to withstand the sweeping winds and gives way to the pines. The type may be divided into two sub-types, the "open" and the "dense". Differences in site quality are responsible for the subdivision. High glacial valleys and other places sheltered from the wind have the denser stands but the best timber is in protected saddles where there is plenty of snow without slides or side pressure. The heavy stands are somewhat more numerous on north than on south slopes but there are some good patches on southern exposures. Most of the high glacial valleys have only a little fir, which comes in, however, in sheltered places a little lower down. The open sub-type occupies the ridges and other exposed places and is very open indeed.

All age classes are represented throughout the type but the predominant class in most cases is the small pole. This is attributed to the fires that swept the northern country between 50 and 100 years ago and to the more recent cuttings on the Independence and Ruby Mountains.

At the lower altitudes the ground cover is fairly dense and consists of various weeds eaten by

sheep. Higher up, where the fir is not plentiful, the ground is usually quite bare. The alpine species are light producers of litter and the snow water washes much of the humus away from the steeper places while the wind carries off most of the remainder.

Seedlings in the alpine type are frequently found to be very little shaded. The fir is aided by moderate shading but the pines seem to prefer almost full sunshine and are frequently found on bare, gravelly soil that is covered with snow until June. The fir is more apt to be found in places where there is some humus.

Fire has been responsible for a very considerable reduction of area in this type. In aspen stands at elevations around 7,500 feet one is apt to find old fire-scarred fir trunks and stumps. The fir is regaining its place but the process is extremely slow in spite of the fact that the aspen does not offer effectual resistance and, indeed, offers favorable conditions for fir seedlings. The small aggressiveness of the fir is due in part to its poor seeding ability. Sometimes a fire in the alpine type has been followed by ceonothus. The ceonothus, in turn, is being suppressed by aspen and under the aspen are fir seedlings. In the paths of old avalanches and on old burns one finds ceono-

thus being suppressed by fir and pine without the intervention of aspen. On south slopes dryness has kept back the ceonothus and sagebrush has invaded the burns. In these cases the trees are helpless and such areas do not show signs of recapture by the timber.

The alpine type calls more strongly for conservative treatment than any other type. Occupying the mountain tops it is more subject to the elements than the others. Wind and snow deform the trees and frequently avalanches sweep the cover from considerable areas. The infrequency of seed years and the destruction by birds and rodents of the greater part of the seeds that are produced always makes reproduction problematical.

Again, the alpine type occupies the highest, most mountainous lands where the snow is heaviest and where the run-off is likely to be most rapid if not checked by vegetation. The high snow lands are most important on the Humboldt because they are the sources of the permanent streams on which the ranchers depend. Anything that threatens the efficiency of the type as conservator of moisture, also threatens the prosperity of the ranchers for miles below. Properly managed, the type serves as a series

of storage reservoirs. Cut heavily, the type no longer serves fully in its most important capacity, the streams are flooded with water when it cannot be used and they dwindle or dry up when they are most needed. Further, the use of water from the Humboldt for irrigation has just begun. The land area available is much greater than the water can ever irrigate and, while some water gets by without being used, at present, this condition cannot last long. It follows that the type is much more valuable for protection than it can possibly be for timber and marking should be very light. Insect attacks in some places have made cutting advisable but, in all cases, great care should be used to make the cutting as light as economic conditions will allow. Sometimes the removal of infested trees is more urgent than the keeping of all the trees for watershed protection. In this case, the marking may be liberal enough to attract buyers who would be unwilling to bid otherwise.

In the lower part of the type, at a few places, one finds fir stands that would not be injured by thinning but cutting should not be allowed in the stands in which the pines predominate, except in cases of insect infestation. The pine stands al-

ways occupy exposed positions that cannot be held by any other cover.

Lopping and scattering of the brush is always advisable in the alpine type.

Dead timber does not often menace the forest but it should always be removed when its sale is possible, if for no better purpose than the opening up of roads into the timber. The dead wood, of course, depreciates somewhat each year and its early removal is advisable from a financial standpoint.

SILVICS BY SPECIES.

Description

Limber pine attains an average maximum diameter of 22 inches and a height of 45 feet. Essentially a solitary tree, it usually has a typical neglected-apple-tree form but in ravines and in the denser stands, there is sometimes a little clear length. The trees have small tendency to push up above their fellows and the tops are often somewhat flattened even in young trees. A clear length of twelve to sixteen feet is not uncommon in dense pole stands, but greater clear length is not often found. The root system is very shallow and consists of a few short misshapen clubs that extend only a short

distance from the trunk and terminate in many long slender branches. The species is generally wind-firm because the trunks are short, the leverage is small, and the root system, while shallow, covers a considerable area. Limber pine can survive considerable ground fire injury. Low cat faces are common in some stands.

White-bark pine is almost identical with the preceding species and the same description is applicable to each. However, the white-bark pine is probably inclined to have more clear length than the limber pine. There were so very few cones during the past season that it was impossible to arrive at definite distinction^s between the two trees.

Single-leaf pine attains an average maximum diameter of eighteen inches and a height of forty feet. The crown is typically open and loosely spreading with large, heavy branches, originating close to the ground. Many trees have no clear length, while a length without limbs of twelve feet is seldom found except in the moist canyons. The tree is windfirm and has heavy roots that seem to reach considerable depths without much lateral extent. Roots of single-leaf pine are much less damaged by fire than the roots of the mountain pines.

Alpine fir attains an average maximum diameter of twenty-four inches and a height of eighty feet. The tree seldom has more than ten feet of clear length and the form is that of an unsymmetrical, rapidly tapering spire, ending in a tall slender spike. Many firs have had their tops blown out and frequently four or five new vertical shoots take the place of the top. The branches early acquire a downward bend from the weight of the snow but the strong geotropic tendency is shown by the fact that in wind-thrown trees the branches send up vertical shoots. The bole tapers rapidly and is likely to be rough, defective and full of bad knots. Occasional trees are found to have not more than 1 per cent taper through the first log but these trees are exceptional. Spiral grain lessens the value of nearly half of the fir trees. During the past summer the resin pockets were much less prominent than those previously observed in Idaho and Montana. Alpine fir has a shallow root system and is more subject to windfall than the other trees. The roots extend laterally at least as far as twenty-five feet but there is little downward penetration. Surface fires are quite apt to kill the roots or, at least, to injure them so badly that fungus diseases can easily gain a foothold and

destroy the vitality of the tree. A small, old burn at the head of Coon Creek shows the disastrous effects of light ground fires in alpine fir. The trunks and even the small, lower branches of many of the trees were scarcely marked. Yet most of the trees are dead from scalding about the stumps and roots.

Utah juniper sometimes has a stump diameter of twenty inches and a height of twenty feet. The branches spread from near the ground and the main stems taper very rapidly. The crown form is much like that of a low, spreading peach tree. The roots go deep and wide in search of water and the tree is never windthrown. Utah juniper is resistant to fire although it is seldom subject to such injury.

Rocky Mountain juniper attains an average maximum stump diameter of thirty inches and a height of thirty-five feet. The crown is open and flat. The heavy branches spread from near the ground as in the Utah species but they are much longer and they taper more regularly in the Rocky Mountain species. The bole is usually scarcely more significant than the larger branches. It tapers very rapidly. Rocky Mountain juniper has a widely extending root system but the downward penetration is not great. The trees are never thrown by the wind. Fire injury is rare

and is not likely to be serious. Some old trees have large cat faces but their vitality seems little impaired.

Nuttall's willow attains an average maximum diameter of fourteen inches and a height of forty feet. The crown is like a ball on ^a cylindrical bole and the form frequently resembles that of a pollarded willow. The root system is shallow and does not have a wide lateral extent. Wind-throwing is unknown and fires very seldom occur in places frequented by the willow.

Almond leaf willow does not attain the form or dimensions of trees.

Aspen attains a maximum average diameter of twenty inches and a height of sixty feet. Trees that have not been subjected to deforming influences other than the shading of competitors, have open, ball-like or cylindrical crowns, with occasional scrubby branches persisting below the principal tops. The bole is smooth in four to eight foot lengths, but at these intervals there are often rough knots from persistent branches. The taper is not great in mature trees until the crown is reached. Here the tree takes on a more or less delinquent **form** and there is seldom any better material than firewood above the

first vigorous branches in mature trees. Younger trees are apt to have live branches on the lower part of the bole or, at least, to have a less pronounced deliquescent form. The injury by snow to sapling trees has been discussed. Aspen has a shallow root system, especially on the moister situations. Only a few windthrown trees of this species have been observed but I am confident that the lateral extent of the roots does not exceed twenty-five feet on each side. The tap root is insignificant except in small trees. Aspen roots are not at all resistant to fire. The sprouting power is easily destroyed.

Balm of Gilead in Jarbidge Canyon attains a maximum diameter of thirty-six inches and a height of eighty feet. The average maximum dimensions are twenty-four inches and fifty feet. The bole in mature trees is smooth and clear to heights varying from thirty to fifty feet. The crown usually consists of a number of heavy branches originating rather close together. Many of the older trees have had their tops blown out and such trees often have crowns resembling groups of young trees. The species probably has a moderately strong tap root and well developed lateral roots. Growing in canyons, it is not subjected to hard winds. Sometimes the spring floods wash out the

earth from about the roots and then windfall results. Otherwise the species is windfirm. Balm of Gilead should be securely resistant to fires in its above ground parts but the roots are probably not able to survive the scorchings of brush fires.

Narrow-leaf cottonwood occurs rarely on the Forest but the average maximum diameter for the region is eighteen inches and the height is sixty feet. Most of the trees on the Forest have been deformed but the normal tree is typically excurrent and the bole is cylindrical and only slightly tapering in the lower half. The roots extend widely and trees are seldom windthrown. The roots are perhaps less subject to fire injury than those of aspen.

Alder attains an average maximum diameter of eight inches and a height of thirty feet. The tree practically always has a shrub-like form, several recumbent branches starting from the base at the ground surface and spreading to form irregular cup or vase shapes. The large branches, which may be considered as boles, are free from branches for five or six feet from their bases. The outer portions are heavily branched. Alder has a shallow root system but is not subject to windthrowing. The lateral roots

probably extend twenty feet on each side. The roots are not resistant to fire.

Mahogany trees, eighteen inches in diameter at the ground, fifteen feet high and of nearly perfect globe form are occasionally found. The average tree, however, is much smaller and shows slight symmetry. The winds have a tendency to make the tops of the crowns level, or on a single plane. The supporting framework consists of rough, crooked limbs that originate near the ground. Mahogany probably has deeply extending roots but the lateral extent is not great. The species has no resistance to fire except in the case of small trees, which sprout after light fires.

Service berry does not become larger than a small, deformed shrub. It occurs in open patches of much overgrazed brush.

Cherry attains an average maximum diameter of six inches although there is a nine inch tree on a tributary of Meadow Creek. It is usually more of a shrub than a tree, perhaps due to sprouting induced by grazing. Cherry seldom becomes more than twenty feet high. The crown is open and shows something of the spray effect common to Prunus serotina. The bole tapers rapidly and has numerous small knots

but the small trunks are sometimes used for buck rake teeth because the wood resists abrasion better than other available woods.

Mountain ash is only a shrub on the Humboldt. It sometimes attains a diameter of three inches along mountain streams and sometimes covers considerable areas with low, dense brush.

Blue elderberry occurs singly and does not become larger than two inches in ^{ground} diameter and eight feet high.

Acer glabrum is a sprawling shrub. The slender stems seldom become larger than one inch in diameter and five or six feet long.

H A B I T A T .

All of the species are limited by the factor of exposure, more as it affects the soil and air moisture than directly. Aspen is found more frequently on northern than on southern slopes because the snow stays later on the north slopes than on the other exposures. At high altitudes exposure does not seem so important as at lower places and this fact strengthens the theory that exposure does not have any important influence aside from the effect on soil and air moisture. However, using a less technical meaning of the word, there is a marked difference in ability to with-

stand the wind, and cold. Limber and white-bark pines can endure more exposure to the drying winds at high elevations than any other species. The trees often assume fantastic sprawling shapes and, indeed, one can usually find some special protection to account for a well formed tree. Alpine fir is always found below rather than above the pine, and sprawling Juniperus communis occupies about the same position as to altitude although its occurrence is rare. Neither species has the hardiness of pine. Aspen cannot withstand much direct exposure and is found almost altogether in somewhat sheltered places. It frequently crouches in the lee of crests that favor the formation of deep drifts. Mahogany is able to withstand almost any degree of exposure that is found below an elevation of 7,000 feet. Single leaf pine and the desert juniper have much the same characteristics of range with the mahogany although they are usually on gentle slopes at the foot hills rather than on the ridges themselves, as with mahogany. The other species are usually confined to sheltered places, the principal cause, however, being their need of abundant water.

ALTITUDE TABLE

<i>Pinus flexilis</i>	7,000' - 10,500 *
<i>Pinus albicaulis</i>	6,500 - 10,500 *

<i>Abies lasiocarpa</i>	6,500' - 10,500 *
<i>Juniperus communis</i>	7,000 - 10,000
<i>Populus tremuloides</i>	9,000
<i>Prunus demissa</i>	7,500
<i>Juniperus utahensis</i>	5,000 - 7,500
<i>Pinus monophylla</i>	5,000 - 7,500
<i>Juniperus scopulorum</i>	7,000
<i>Salix amygdaloides</i>	7,000
<i>Cercocarpus ledifolius</i>	7,000
<i>Populus balsamifera</i>	6,500
<i>Alnus tenuifolia</i>	6,500
<i>Salix Nuttalli</i>	6,500
<i>Populus angustifolia</i>	6,250

* These species would grow at higher elevations if there were any soil or if there were any protection.

Gradient is not a factor in limiting distribution except as it influences snow, ground surface and soil moisture. Aspen on steep slopes is often badly deformed by snow and the species is thus limited.

Seedlings of the alpine species are bent and broken off in the same manner. At high elevations, the surface of steep slopes is often covered with slide rock or small gravel so that even the alpine species cannot obtain a footing. The rapid draining away of

water from steep slopes prevents the growth of aspen in some cases. Mahogany grows on steep slopes that are too dry for other species.

Utah juniper has been reported as limited to the lime stone formation. I have observed no preference on the part of any species for any particular kind of soil altho the juniper type has not been studied to any extent. Sometimes it has seemed that the soil had a marked influence but, in each case, further observation has pointed to the fact that soil and air moisture are the principal factors in determining the range of any species on the Forest.

Aspen requires an abundant supply of water and is barred from the higher places by the drying effects of constant winds and extreme cold. The coniferous species are admirably adapted to withstand the excessive drying influences that prevail at high altitudes while the aspen is not prepared to retain its moisture under such conditions. Alder, willow and the cottonwoods are, of course, water loving species and they are confined strictly to moist places although the willows and alder are very alert in capturing places that have moisture even though it be only a small isolated seep. Rocky mountain juniper requires an abundance of

moisture in soil and air but the desert species, like mahogany and single leaf pine, is exceedingly modest in its demands for water. In a few places, however, mahogany is found thriving on well watered places (Lamoille Canyon).

Soil And Moisture

Alder and willow never occur except in well watered places and the soil seldom becomes too heavy for them on the Humboldt. The larger Populus species, and Rocky Mountain juniper require abundant moisture but require better drainage than the alder and willows. The mountain top trees all require abundant water during the early summer but frequently have to endure moderate drought later in the season. A Aspen has much the same moisture requirements as the trees just mentioned but can stand more dryness of soil and much less dryness of air. Mahogany, Utah juniper and single leaf pine have remarkable ability to thrive on dry soil. These species, occupying gravelly slopes, are able to hold their moisture against the hot, drying winds from the open country and to make a little growth in spite of the hard conditions. Mahogany requires more moisture than the other two species.

Chemical characteristics of the soil have not been observed to have any effects on tree distribution

within the Forest. Alkali sometimes prevents the growth of willow around watering places on the range lands without the Forest. Physical qualities are equally unimportant. The moisture balance is undoubtedly the chief factor in limiting each species. The assigning to each species of its theoretical requirements for soil quality is somewhat difficult because each species is usually limited to particular places from which most of the other trees are excluded and the limiting factor is nearly always the soil moisture or else the dryness of the air. Wherever one goes on the Forest the types are found to have about the same conditions of altitude, exposure, and moisture, and this in spite of wide differences in soil.

The arrangement that follows is based on the probable requirements of each species for soil quality and moisture.

Soil Quality

Moisture

Dwarf juniper ()
 Mahogany) Least
 Utah juniper) fastidious.
 Single leaf pine ()

(Utah juniper
) Single leaf pine
 (Mahogany
)

Limber pine ()
 White bark pine (Moderate
 Alpine fir) requirements.
 Aspen ()

(Aspen
) Dwarf juniper
 (White bark pine
) Limber pine
 (Alpine fir

Narrow leaf cottonwood)
 Willow ()
 Cherry) Most
 Western juniper (fastidious)
 Alder)

(Western juniper
) Narrow leaf cottonwood
 (Willow
) Alder

Tolerance Of Shade

It is not possible to compare the trees on the basis of light requirements with satisfaction because the natural obstacles to tree growth are so great that each species, having particularly good resistance to some one of the adverse conditions, is able to monopolize situations from which the other species are excluded by their inability to combat the same adverse condition. Thus, mahogany occurs alone on dry, rocky buttes. Aspen occurs in pure stands on the lower slopes that are well watered from snow drifts until mid-summer and afterward often dry. Limber and white bark pine are alone able to withstand the cold, dry winds on the mountain tops. Trees growing under such adverse circumstances do not crowd each other, except in the case of aspen. Only in the canyon bottoms does one find any real inter-species competition. Here, the narrow leaf cottonwood is least tolerant, followed by aspen, Balm of Gilead, and willow. The following table of probable tolerance is based on the foliage characteristics of each tree, assuming that the open topped trees are intolerant and vice-versa.

Intolerant

Limber pine (Most intolerant)
White bark pine
Single leaf pine
Narrow leaf cottonwood
Aspen
Balm of Gilead
Mahogany and Cherry

Tolerant

Dward juniper
Utah juniper
Western juniper
Alpine fir
Alder
Willow (Most tolerant)

A clear example of an inferior species being replaces by a superior species is shown in the case of the extremely intolerant Ceonothus velutinus which is quickly crowded out by aspen. Ceonothus in this region seems to be much less tolerant than the same genus in Pennsylvania.

Growth

Owing to the absence of inter-species competition, the only important variation in rate of growth for each species is due to differences in site quality. The greatest variation is found in the species that are able to occupy exceedingly unfavorable as well as better situations. The water loving species, being confined to bottoms of essentially uniform character show the least variation in growth rate.

Aspen, on slopes that are covered with heavy drifts during the winter and spring months, has very slow growth while in canyon bottoms and other places where the snow does not exert a strong deforming influence, the growth is rapid. Thrifty trees between the ages of thirty and seventy years frequently gain an inch in diameter every four or five years and more rapid growth is not unusual. Height growth is rapid in dense stands on good situations, but most of the height growth is made before the fortieth year.

On Tennessee Mountain a dense, thrifty stand of aspen sprouts reached an average height of twenty feet in fifteen years.

The most rapid growth of fir occurs between the ages of fifty and ninety years although it is sometimes found that a tree has been most vigorous at 110 years. A diameter growth of 1.5 or 1.8 inches in ten years is not uncommon but this rate usually marks the period of greatest activity, the growth of adjacent decades being less. The average growth of fir throughout its life is probably about .1 inch per year.

The mountain pines usually show very slow growth without any periods of marked vigor. An apparently vigorous pole was found to be sixty-eight years of age although the diameter was less than six inches. Some of the old gnarled trees grow so slowly that the rings cannot be counted without a magnifying glass.

Mahogany, single leaf pine, and Utah juniper, occupying frontier positions, grow very slowly. No counts have been made for these species. Their sprawling, open form makes the usual units of measurement rather meaningless. About the only practical unit for describing the growth of these species would be cubic feet or cords per acre per year and the stands are so absolutely lacking in anything approaching uniformity

that an estimate of growth rate must be considered very general. .2 cord per acre per year would be good growth for a fully stocked stand. These species do not occur in the dense stands characteristic of countries more favorable to tree growth and a stand that shades half of the ground at noon is exceptional.

, Age Limit

The following table is based on very general rather than on specific observations, except in case of the starred species:

Natural age limit at which tree remains sound and vigorous.

*Pine, (mountain species)	180 - 200 years
*Fir	150
Single leaf pine	150
Juniper (Desert)	100 - 200
Juniper (Rocky Mountain)	150 - 300
Narrow leaf cottonwood	130
*Aspen	80 - 100
*Balm of Gilead	160
Willow	30
*Alder	50
Cherry	50
Mahogany	100 - 150

Merchantable Age

Wood of all sorts is so scarce on some parts of the Forest that there is no lower limit of use for any species. However, dropping firewood from consideration, the following sizes and ages are applicable as at the lower limit of merchantability:

MERCHANTABLE SIZE AND AGE

SPECIES	M A T E R I A L									
	Round	Log	Posts	Corral	Poles	Tele-	phone	Poles	House	Logs
	DBH	Age	DBH	Age	DBH	Age	DBH	Age	DBH	Age
Aspen	3" - 10	5" - 15	5" - 15	10"x20'	35	10" - 40				
Fir	3" - 20	5" - 35	4" - 30	10"x20'	80	10" - 100	12" - 120			
Mountain Pines		5" - 50		8	100	10 - 130	12" - 150			
Western juniper	4" - 20	6" - 35		12" - 120	10" - 100					
Single leaf pine		50" - 50			10" - 120					
Utah juniper	Pieces									
	Branches	6" at the butt	are used for posts.							
Alder	Pieces	8" at the butt	are used sparingly for posts.							
Willow	Wattle	corrals, 1", 5 years.								
Cherry	Buck	rake teeth at 3", 20 years								
Service Berry	Wood	nails and other small pieces, 5 to 15 years								

SEED PRODUCTION

The Populus species, like willow and alder, seed abundantly practically every year. Cherry is a good seeder as are the junipers and mahogany. Single leaf pine is not so consistent as the former species but there are usually a few cones and a heavy crop is said to occur each two or three years. The mountain top pines seldom have heavy seed crops but some trees have a few cones each year. The average annual seed production of these species is very small. Alpine fir is even less prolific. During a summer's field work only three trees were found bearing cones and one of

these had been thrown by the wind a year ago and was thus stimulated to seed production. A number of trees had spikes from last year's cones but the general crop must have been almost negligible. Magpies and rodents are responsible for much damage to the seeds of all of the pines and the fir.

SEED PRODUCTION

Most prolific, first named.

- Alder
- Aspen
- Willow
- Narrow leaf cottonwood
- Balm of Gilead
- Cherry
- Western juniper
- Pinyon pine
- Utah juniper
- White bark pine
- Limber pine
- Alpine fir

SEEDLINGS

Owing to the great scarcity of seedlings in the alpine type, during the past season, the subject of reproduction cannot be satisfactorily discussed.

Alder, willow, and the cottonwoods produce seeds that germinate as soon as they are liberated, early in the spring. Mahogany seeds drop in the autumn and sprout the following spring. The feathered seeds have been found a hundred and fifty feet from the trees. They roll along readily when the wind is blowing.* Fir

and pine seeds, that escape the birds and rodents sprout in the spring.

Willow and alder germinate most readily in places where they have been washed along with fine vegetable matter around the edges of little eddies of the streams.

Aspen, Balm of Gilead and narrow leaf cottonwood seedlings grow under the conditions just described but they are more successful in mineral soil that is well watered but also well drained. All of the species mentioned are barred from places that do not have much water and they are unable to obtain a foothold where there is much grass or weeds. Mahogany seedlings are able to do well in slight depressions in the rocks that gather soil and moisture. The species cannot endure much shade. The western juniper thrives on moist, well-drained mineral soil while Utah juniper, like pinyon pine, grows best on mineral soil that has very little surface water except in the spring. The mountain top pines prefer the bare, mineral soil below persistent snowdrifts but cannot establish themselves satisfactorily where the snow goes off early and rapidly. Many of the little seedlings, being covered with heavy snow drifts, become deformed early in life. One is

frequently impressed with the fact that these species reproduce most vigorously on places that would seem to offer the least inducements to tree growth.

The climate has a large influence on seedlings of all species. A dry spring followed by a dry summer is very likely to prove disastrous to the season's reproduction because, unless there is some surface moisture to carry the plants until the roots have developed enough to supply the necessary water from a dry soil, failure will result. Sheep and cattle do a certain amount of damage to seedlings, especially of aspen, but the effects of grazing on coniferous seedlings have not been worked out because there have been very few seedlings to sustain injury and other feed was unusually abundant during the past season.

SPROUTING

Aspen sprouts vigorously from both the root and stump if the cutting was not in the hot summer months. Stump sprouting is shown admirably on Tennessee Mountain where the original stand was cut fifteen years ago. The sprout stand is very dense and has every appearance of thrift. The trees are between two and four inches in diameter and the average height is about twenty feet. Trees under eight inches in diameter are good

sprouters but the larger trees do not have the same vigor. Root sprouting often occurs, without any apparent provocation, in pole stands, but these shoots are apt to be short lived, both because of competition for light and because of grazing injury.

Narrow leaf cottonwood and Balm of Gilead are hardly so vigorous in sprouting as aspen. Pole trees up to six inches in diameter sprout strongly if the cutting was in the winter or spring but the larger trees do not have the same power. Root sprouting is less frequent than in the case of aspen.

Alder and willow, of course, sprout with great vigor. In some places where these trees are used extensively for fuel, a cutting can be made every ten years or even less and the pieces average three or four inches in diameter at the stump. The Indians of Duck Valley Reservation use considerable amounts of willow for coarse basketry and a study of their work would be interesting although of small economic value because there is no real market for baskets.

Mahogany sometimes sprouts if it is cut before the tree is more than three or four inches in diameter at the ground. Larger trees show no life after cutting. The sprouts come from the roots and the stump but roots sprouting is perhaps more common.

DANGERS AND DISEASES

Wind is responsible for only a small amount of damage on the Humboldt. Fir trees are sometimes found to have lost their spikes but this is not of much importance except as it destroys the usual cone bearing parts of the trees or allows the entrance of fungus enemies. The wind is important in its deforming influence in the case of the alpine species but it is unusual to find wind thrown trees anywhere on the Forest.

Snow slides have been frequent in the Jarbidge Mountains and many trees have been carried out in the past. These slides are often surprising because they have occurred in places that one would not consider subject to such action. It seems to require only two or three hundred feet of horizontal distance (Head of Fox Creek) to store up enough snow to clear the trees from an area whose length depends on the gradient and straightness of the course. At the head of path the trees may be merely overturned but lower down, they are apt to be swept bodily from their positions and carried off. Something of the depth of a slide can be found by observing the direction in which the trees lie after the snow has melted. Unless the

structure has been complicated by turnings, trees thrown downhill indicate a deep slide while trees thrown with the top up hill indicate a fast, shallow slide. On Merritt Mountain a slide on the north slope cut a wide swath through one of the best stands. The debris from slides is seldom enough to block the streams to an important extent. Most places that have been scoured by avalanches are reproducing excellently, the fir being more abundant in most instances. Frost cracks occur, rarely, in alpine fir.

Lightning injury is very rare. Thunder storms are not frequent and they are not so violent as in other regions. Alpine fir, with its tall spires, is most susceptible but the injury amounts to only a small fraction of one percent. Aspen trees have been reported as struck by lightning. The absence of humus and ground cover and the rarity of dry stubs renders lightning comparatively harmless for, although a tree may be struck now and then, the bolt enters the bare ground without starting a fire. Again, the trees are not very inflammable, compared with other species.

Fomes ingiarius is responsible ^{for} ~~to~~ occasional injury to aspen but its occurrence is rare. Another fungus disease, probably Trametes pini, frequently attacks alpine fir, riddling the lower ten or fifteen

feet and reducing the first log, at least, to punk. Aspen seedlings and young sprouts are attacked by powdery mildew which kills the upper leaves and the soft growing tips of the main stems. Fungus diseases are singularly rare on the Forest, perhaps because of the isolation of the trees.

Insect larvae are found boring in aspen poles through-out the forest. The bark of attacked trees becomes discolored and sunken above and below an elongated hole from which sawdust and a brownish-amber syrup-like fluid fall over the trunk and the ground. The interior wood is bored out in parallel vertical channels that sometimes reduce the trunk to a honey-comb for a few feet. The injury is usually not so severe, and damaged trees are often suitable for posts or other short length products. The principal attacks seem to come in July. The ichneumon fly has been described to me by men who saw it at Jarbidge in August.

The only insect damage of importance is that of Dendroctonus monticolae. The high mountain pines are attacked most frequently but alpine fir is also subject. Infestation occurs in small groups of trees. In the "Howard timber" and ^{at} the head of Coon Creek it was noticed that the infested areas were somewhat lengthened in the direction of the prevailing winds.

The broods emerged between the middle of July and the middle of August during the past summer. At lower altitudes broods emerge early but on the higher places pupae were found, not nearly ready to come out, on July 31. The principal flights were about the first of August and shortly after this many hitherto untouched trees showed the characteristic pitch tubes. In some cases the insects traveled a half mile or more but as a rule the flights were much shorter. Trees attacked in the middle of the summer turn to a bronze color by October and are dull red the following spring. A year after the attack a tree is usually dead and the insects have left for new fields. It seldom happens that a tree is attacked by such a small number of insects that it can survive. Most of the trees have their inner bark thoroughly riddled by vertical channels from three feet above the ground to a point twelve or fifteen feet higher. Above and below this belt, the channels are not so numerous.

The thicker bark and more abundant resin of the fir make entrance harder for the insects than in the case of the pines and this fact sometimes gives the fir immunity from attack when there are numerous pine trees in the vicinity. At the head of Coon Creek the insects have avoided the thrifty fir and have at-

tacked the limby pines several hundred feet higher.

A very few firs have been attacked by a twig borer, a weevil that tunnels around the inner bark of small twigs. Attacked trees have most of their small twigs red or brown. The insects probably leave the trees when most of the small twigs have been killed and the attacks should not be fatal in normal trees. Adults may be captured at the middle of August. Although only isolated trees have been attacked, the tops might well be lopped and burned early in the summer in order that the insects may not become more numerous.

There has not been much opportunity to study the effects of fire but it is probably true that alpine fir is most susceptible, followed by the mountain pines and aspen. The larger cottonwood species with their thick bark should withstand considerable heat. Fir has been found to be very easily killed by light surface fires and aspen has been killed by brush fires of somewhat greater intensity.

Mahogany is quite easily killed but juniper and single leaf pine are resistant. The sprouting power of aspen and mahogany is easily destroyed by fire.

A case of serious injury by insects will be discussed under "New York-Nevada Gold Mining Company's trespass cutting" in this report. In this case nearly

all of the mountain pine trees have been killed. The Howard timber, where the Staley & Olds sale is now being administered, has small groups of insect killed pines. In this case, the damage has been going on for several years but so slowly that the total amount of dead timber is not large. If unchecked, the groups would spread until the entire stand would be killed. The Deer Creek timber, a similar pine pole stand, has a few small groups of trees killed by *Dendroctonus* and throughout the Jarbidge Mountains small areas of infestation can be found. Evidences of *Dendroctonus* were found on old fire scarred trunks on Deer Creek that must have been dead at least thirty or forty years ago, judging from the size of the young trees that succeeded them.

There have been no windfalls involving more than a few trees.

The important fires occurred between ten and seventy five years ago. Most of them have started from canyon bottoms and swept up toward the ridge tops. They were probably set by Indian hunters but more recently the sheep men have burned out the brush and timber (Bear Creek for instance) to open up drive-ways for their bands. The more important burns are in the Jarbidge Mountains and are located on Bear

Creek, Pine Creek, Fox Creek, Jack Creek, East Fork and Canyon Creek. The Bear Creek fire occurred fifteen years ago. The fir trees in the canyon were generally killed although considerable patches escaped. In this fire most of the trees were killed without being severely burned and a considerable amount of dead timber has been taken for structural purposes in small sales to Jarbidge people. Ceonothus has captured a considerable part of this area and fir reproduction is making its way up through the brush.

The Pine Creek and Fox Creek fires occurred many years ago. They were destructive and very little timber is now standing. Reproduction has not come in and the land has been taken by grass, sage brush and other brush. The timber at the heads of these creeks was not so badly injured but the trees along the side ridges, further down the streams, were about all killed and there is very little seeding.

The Jack Creek (Jarbidge Mountains) fires occurred perhaps twenty-five years ago. They have been followed largely by ceonothus and the reproduction over much of the area, is encouraging. Pine is more abundant than fir because the seed trees of the neighborhood are nearly all of the former genus.

Small patches of timber throughout the high

land draining into East Fork have been burned long ago. In some places the reproduction of fir and pine is excellent but many years must elapse before the timber regains all of the land included within the permanent type.

The Canyon Creek fires did not cover large areas but destroyed considerable amounts of timber. Reproduction of fir and pine in this region is encouraging.

Throughout the Forest one finds evidences of old fires but the descriptions above are typical of all. Everywhere the timber occupies only part of the natural timber land and the recapture is slow.

The only serious fungus injury observed was in the fir included in the Jarbidge-Pavlak Sale. The smaller trees escaped the disease and some of them were so punky, in spite of apparently fairly healthy condition that they had to be abandoned entirely. Some of the infected trees in the sale had their tops blown out and this condition is common throughout the forest. Doubtless the same conditions exist in many other stands of fir but they have not been observed because there have been very few cuttings and fruiting bodies are exceedingly rare even in places where many trees are affected. No fruiting bodies were found on the sale area. It is probably true that no fir over 28" D.B.H. is sound.

^{al} Parasitic plants are most entirely absent. A

A case of mistletoe on limber or white bark pine (head of Pine Creek) was described to me but the condition is rare.

Grazing did not cause important injury to the alpine type during the past season. Even in places where the ground has been considerably cut up by sheep, it is difficult to find seedlings that have been injured. I have found no evidence of sheep stripping the leaves or tops from conifers. However, nothing very definite can be stated until there has been a seed year. It would not be advisable to allow sheep on cut-over areas for a few years after cutting unless the tops and branches should be sufficient to protect the seedlings. The possibility of using sheep for treading in the seeds have been considered and abandoned because most of the seeds would be gone by the time the sheep could enter the type.

Sheep and cattle are responsible for considerable injury to aspen sprouts and seedlings. Sheep, especially, strip the leaves and bite off the tops. This injury is of some importance in the more open stands because it prevents them from attaining normal density, and on cut-over areas because it prevents the re-establishment of the cover. Injury by animals cannot well be described by averages. In places much

frequented by sheep or cattle, practically every young aspen shoot may show injury while other places, not attractive to stock, may show no damage. If the surrounding feed is good, the aspen will be eaten sparingly for its bitter taste rather than for food.

(Robinson Creek)

A band of sheep in a rough canyon just outside of the Forest, had too little feed and in this case the aspen suffered, even the bark of small poles being gnawed. Stream bottoms, where the sheep spend the hot part of the day, are apt to show severe damage to the young shoots. Willow leaves and twigs are nibbled by sheep and service berry is eaten by both cattle and sheep but these species receive no injury of economic importance.

VERTEBRATES

Injury by wild animals and birds is confined to the alpine type, excepting the work of beavers in felling the stream bottom trees. The destruction of coniferous seeds by squirrels, mice and magpies has a strong influence in limiting the type. Undoubtedly the other birds are of service in destroying insects but no specific examples have been observed on the Forest. The woodpeckers prefer dry telephone poles to green trees for their work. Porcupines eat the bark from occasional trees of the mountain top pine

species. Beavers are numerous on many parts of the Forest but their damage is not important since the trees attacked are good reproducers.

SAMPLE PLOTS

Two enclosures have been established for the purpose of obtaining contrasts between land on which grazing is allowed and land from which stock is excluded. Altho these areas have been fenced only one year, both show variations from the open land.

The Merritt Mountain enclosure is located on the head of Telephone Creek in the open alpine subtype at an altitude of about 8,200 feet. The stand consists of a few firs, with aspen and willow forming most of the cover. Adjoining are sage brush and grass areas. At this place the snow remains until early summer. A series of springs just above the enclosure furnishes a watering place for sheep and cattle and the surrounding ground is badly trampled. Young aspens almost invariably show jagged stumps where previous sprouts have been trampled down. Within the fence aspen seedlings and sprouts are abundant but on the outside, most of them have been bitten off. Powdery mildew has attacked the tips of small aspens, both within and without. Sheep undoubtedly carry spores throughout the area. Within the enclosure there are not more

than ten seedlings of the alpine species and these seedlings are all more than two years old. The fir trees of the neighborhood did not show spikes from cones of last year. A good seed year should furnish valuable data on grazing injury to the alpine type.

The ground cover within the fence is strikingly abundant and consists of small grasses, false hellebore, narrowleaf sunflower, fireweed, geranium, and asters. The weeds that were broken down by last year's snow formed nearly half an inch of dry humus, suggesting the possibility of great improvement of the soil in the alpine type by the exclusion of sheep. Outside of the fence the ground is bare in considerable patches and shows marked contrast with the ground inside.

The Tennessee Creek enclosure is in the aspen type at an elevation of about 7,800 feet. Two-thirds of an acre of typical cut-over aspen is included. The cutting occurred fifteen years ago and left the stand open and inferior but there is considerable reproduction by seed and by sprouting over the lower half. Grass has come in between the scattered aspen poles and it will be of interest to see how long it takes the aspen to regain the ground to which it is suited. The principal contrast in this case is between the aspen reproduction within and without the area. The feed

is abundant about the enclosure but the sheep like to eat the bitter bark and leaves of aspen and shrubs and the damage to the young shoots is enough to keep the stand open in most places. There is little difference as yet between the humus within and without the fence but the sheep do not frequent the immediate neighborhood of the enclosure so much as other places.

CONDITION OF REPRODUCTION ON CUT-OVER AREAS

The Cuttings.

The New York-Nevada Gold Mining Company's trespass cutting took place on a spur of Copper Mountain in the southeastern part of Township 45 N., R. 57 East.

The Jack Creek cutting was in the Independence Mountains, at the heads of Jack Creek.

The Tennessee Creek cutting occurred on the Forks of Tennessee Creek, just northeast of the peak of the same name.

The Montana Mining Company's trespass cutting was at the head of Van Duzer, Fawn and Indian Creeks.

The Mahogany Buttes cutting took place in the hills on the western side of Sunflower flat and the heads of Telephone Creek.

All over the Ruby Mountains, wherever there

is timber, cutting areas are found.

Unfortunately, for the purpose of this study, there have been no cuttings of importance under the regulations of the Forest Service except during the past season.

DESCRIPTIONS

The Copper Mountain cutting took place during the summer of 1904.

The original forest must have been much like the stand (three-fourths mile north) on Copper Mountain itself which is therefore described. The stand consists of alpine fir and the mountain top pines in approximately equal parts, the fir predominating at the lower elevations and becoming ^{ing} less important higher up. While the timber looks dense from a distance, closer inspection shows that not more than a half of the ground is shaded. Owing to the deep drifts that remain until middle summer, the ground is almost bare except for occasional clumps of fir and pine reproduction. The soil is derived from the andesite formation and consists of fine gravel varying from a few inches to several feet in thickness. Humus is almost entirely absent due to sheep grazing, running snow water and winds. Moreover, the species represented

are not heavy producers of humus. The cutting area is on a gentle to fairly steep slope without gulchs or other minor inequalities.

Naturally the selection system was used. The mining company wanted timber for framing a mill and for sawing into boards, as well as smaller pieces for underground work. Since all sizes down to three inch round lagging were used, the diameter limit was low but only one-third of the trees under eight inches in diameter were taken. The larger trees left by the cutters were too limby or too defective for use; at that, few seed bearing trees were left because numerous defective trees were felled and abandoned.

The brush was left just as convenience dictated. Many of the tops were lopped in order to get out pieces of lagging and these tops have made fair progress toward general decay considering the facts that the snow covers the ground seven or eight months out of the year, that there is very little moisture after the snow leaves and that fungus enemies are not aggressive. Boring insects have done much toward reducing the waste from cutting. The reproduction on the area under consideration is almost negligible. The pines failed almost entirely to come back. The little fir trees occur in scattered groups. The ages vary considerably but nearly all of the reproduction came

before the cutting. In this case, three-fourths of the area will form an open forest of little commercial value although a period of fifty or seventy-five years should allow the fir to partially regain its place. The pine will be unimportant much longer than the fir. Failure of reproduction in this case is due to the fact that most of the seed-bearing trees were cut by the company and that Dendroctonus monticolae has since killed practically all of the pine trees and many of the firs. The small seed production of the alpine species has been noted. Again, the stand has been opened up so fully by the cutting and by the insects that many of the seedlings that might spring up would be denied even the sparse shade that they need.

The Jack Creek Cutting

During the Tuscarora boom a great deal of timber was taken from the alpine type on Jack Creek. The principal cutting was about twenty years ago.

The stands on Jack Creek were characterized by the preominance of fir. While the timber occurred in patches, it was fairly dense and seems to have been of good quality for the type. All age classes were represented, including numerous fir saplings and small poles. The ground cover was probably heavier than in most other alpine stands because in this region the alpine type extends somewhat lower than at other places.

The soil is glacial drift of varying depths and good average fertility. The best stands were on the western side of the Independence Range which is cut, near the crest, by numerous glacial valleys. The timber in the bottoms of these "U" shaped valleys was inferior to the timber on the high slopes. The best timber was at an elevation of about 8,500 feet.

The cutting was for a small mill that made boards and dimension, for mining timbers, for lagging and for cordwood. In the more accessible places, practically everything sound and over three inches in diameter was cut. In isolated places only the larger material was taken. The cutters went to great pains to remove isolated logs.

The brush, of course, lay as it fell in the more inaccessible places and the tops are now well flattened out on the ground. Much of the cordwood removed came from the tops of trees that grew in the smoother places.

The present stand consists of a few old, deformed trees, numerous poles and many saplings, the fir being predominant in all of the age classes except on the higher places. On exceptional situations there are as many as twenty-five fir seedlings and saplings to the square rod with four or five pines. But the

young stand, like the original one, is very patchy and most of the area is covered with sage brush. Young growth of all ages shows only fair vigor. Very little of this area will form a less valuable timber crop than the one removed. Conditions indicate that natural restocking for the alpine type may be expected after fifteen years.

The success of reproduction in this case was probably due to the occurrence of good seed years at the time when the ground was broken up by the logging. Most of the area is unusually favorable to the type and insects have not interfered as in the preceding case.

TENNESSEE CREEK CUTTING

The Tennessee Creek cutting occurred about fifteen years ago, in the fall months.

The stand consisted of aspen poles, both large and small, with occasional seedlings and saplings. In density the stand varied from .3 to .8. The undergrowth consisted of a little service berry and rose brush while patches of ceonothus, following fire, have been suppressed by aspen in the neighborhood. The ground cover must have been very light and probably consisted of sparse grass and weeds with not much humus. The soil is a deep, fertile, sandy loam that is usually well watered by drainage from the upper parts of

the broad basin.

The cutting was for cordwood and practically all of the sound trees were taken, down to a diameter of five inches. The stumps were cut low, the average height being less than fifteen inches.

No disposal was made of the brush that was too small for cordwood but the area is now free from debris.

At present the stand consists of saplings and small poles that have sprouted from the stumps and formed a heavy cover. The next few years will see a marked reduction in the number of trees because the stand is very dense for aspen. Many stumps have two or three sprouts. The average tree is three inches in diameter and twenty-four feet high. There is no underbrush where the cutting was clear and the ground cover consists of very sparse grass and small weeds. In spite of sheep grazing, parts of the area have been covered with a thin layer of humus, composed of aspen leaves.

The reasons for the successful sprouting of the trees in this case were probably as follows: (1) The site is the optimum for aspen. (2) The stumps were cut low. (3) The cutting was in the fall months. (4) The parent trees were at the height of their vigor.

The Montana Mining Company's Cutting.

This cutting occurred in 1906, 1907 and 1908, both summer and winter.

The stand consisted of fir and the mountain pines, the former being far more numerous. All ages were represented, the large poles being most prominent. There was not much undergrowth within the patches of timber and the ground cover was light. The soil over most of the region is deep, moist and fairly fertile while the texture is excellent. The region is mountainous and has many spurs running in different directions from the main ridge which bears about north and south.

Most of the larger trees were taken and many poles were cut for underground use, the diameter limit for lagging being three inches. The cutting was very heavy and almost nothing was left in many places.

The company was required by the Service to take out the usable material from the tops and the brush was piled.

According to all reports, this area has grown up in brush since the cutting, with only a very little fir reproduction. Aspen has encroached to some extent but cannot reach merchantable size under the prevailing conditions.

The failure of reproduction up to the present time is probably due to the lack of seed.

THE MAHOGANY BUTTES

During the Gold Creek excitement in 1895 and 1896 a great deal of mahogany cordwood was cut from the buttes on the western side of Sunflower Flat.

The stand undoubtedly included all age classes, with the old trees predominant. Under growth was absent, as usual, while the ground cover probably consisted of a fair amount of grass and weeds. The soil is grantitic gravel without humus and with little moisture. The region is characterized by rocky buttes, with steep sides, and rough, rocky hollows between.

The larger and more easily accessible trees were selected for cutting. In many cases the stumps were cut so high that much of the wood was wasted.

The scanty brush was undoubtedly left as it lay after the cordwood had been taken but it has largely disappeared.

The present stand is fairly dense (for the type) and consists of widely spreading young trees. Seedlings and saplings are not abundant but the larger sizes are plentiful enough to insure the re-establishment of a stand as good as the one removed. There

is a fair amount of grass and light weeds.

The present condition of the stands is attributed chiefly to the fact that many small, young trees were left at the time of the cutting. Mahogany is an abundant seeder and is able to take advantage of its opportunities. Sheep and cattle injure the little trees by trampling and the sheep often nibble the leaves.

RUBY MOUNTAINS

Cutting in the Ruby Mountains occurred for many years during the prosperity of Eureka. Nearly all of the larger trees were removed for underground work for framing and for fuel. Although there has been no opportunity for examining the scattered patches from which the timber was cut, the conditions are probably about like those in the Independence Mountains, as described before.

REPRODUCTION - General Conclusions

Normal Density.

In a single season one cannot obtain a very good idea of the normal density of reproduction, especially for types that occupy only small areas of the Forest, and are thus not under constant observation. Again, the alpine type is subject to more eccentric

factors than any other known type. Little damage to reproduction was observed during the past season but this fact is no guarantee that the trees will be so fortunate during the next twenty years. Seedlings have been so scarce during the past year that there has been no opportunity for studying the early enemies of alpine reproduction, and no serious enemies of saplings and poles have been found^(except dendroctonus). For the aspen type, the normal density is a little better known but no counts have been made. Grazing injury to all of the broad leaved seedlings renders average counts meaningless but the broad leaved trees are all abundantly able to reproduce themselves.

Distribution

In the broad leaf types, the young growth is usually well distributed, if present at all. Reproduction in the alpine type is nearly always in patches or clumps under the older trees.

Factors influencing reproduction

Undoubtedly the infrequent occurrence of seed years and the dangers that the seeds must pass have the strongest influences on reproduction cut-over land of

the alpine type. The natural rigor of the climate probably has some influence in limiting seed producing capacity of the trees, but even in the best situations the alpine species do not show any marked ability for aggression. The gathering of definite data on reproduction of the alpine type will have to be left until the occurrence of a good seed year.

The reproduction of the alpine type would probably not be attended with great difficulty if light cuttings could be made when there are plenty of cones on the trees. The breaking up of the ground would improve the seed bed conditions and poison scattered about the cuttings should keep down the rodents and birds. It is quite possible that the packed condition of the ground is one of the really important factors in limiting reproduction in the alpine type. Some definite knowledge could be obtained by raking over part of the ground within the Merritt Mountain enclosure after a good seed year.

The broad leaved types are all easily able to regain their cut-over areas unless fire or very heavy grazing has interfered.

---ooOoo---

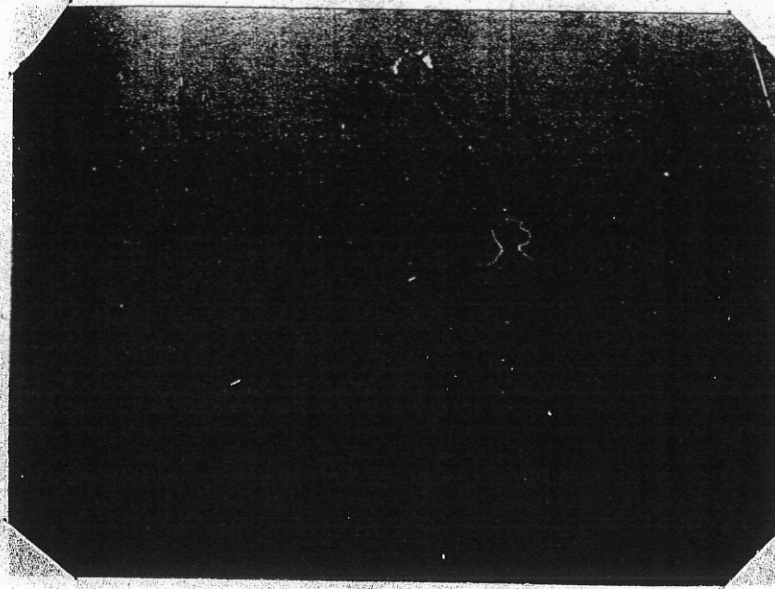
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P H O T O G R A P H S

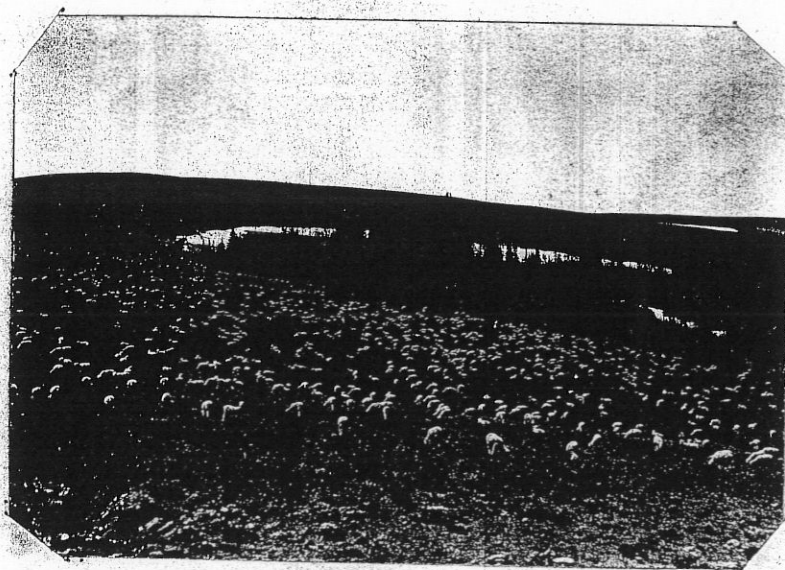
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Copper Mountain

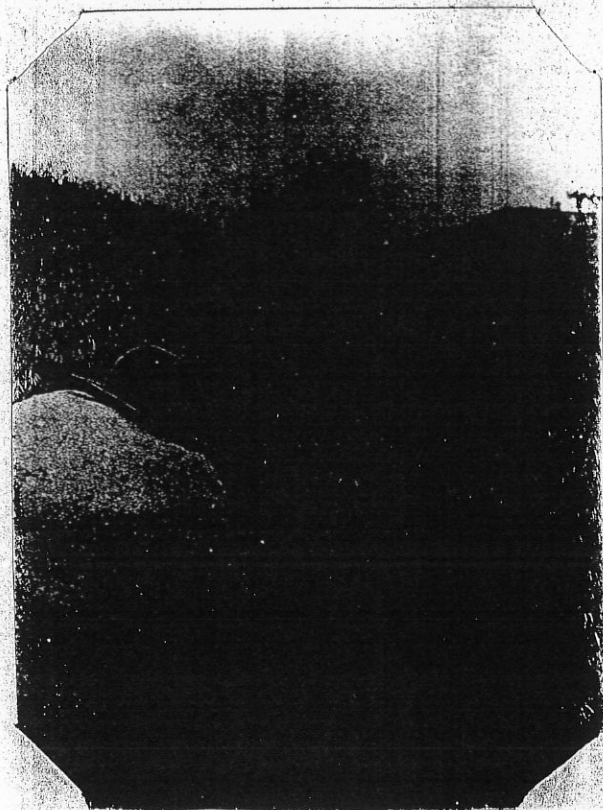


The grass and sage types merge imperceptibly on the high plateaus east of Jarbidge. Elk Mountain in the distance.



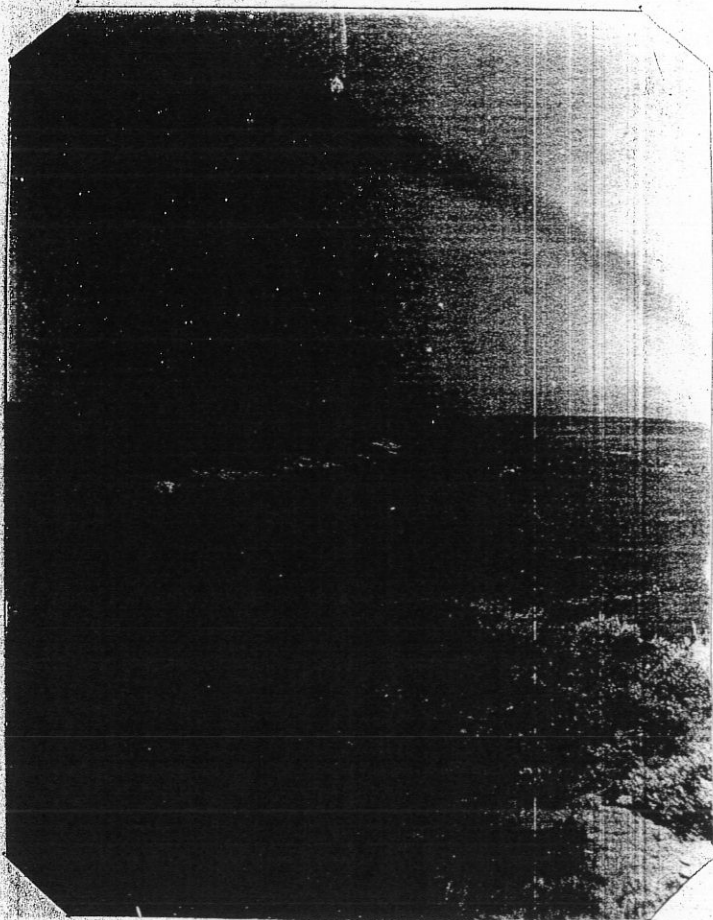
Alpine fir and aspen sometimes occur together in moist places within the grass and sage types. Sheep Creek, Elk Mountains.

2

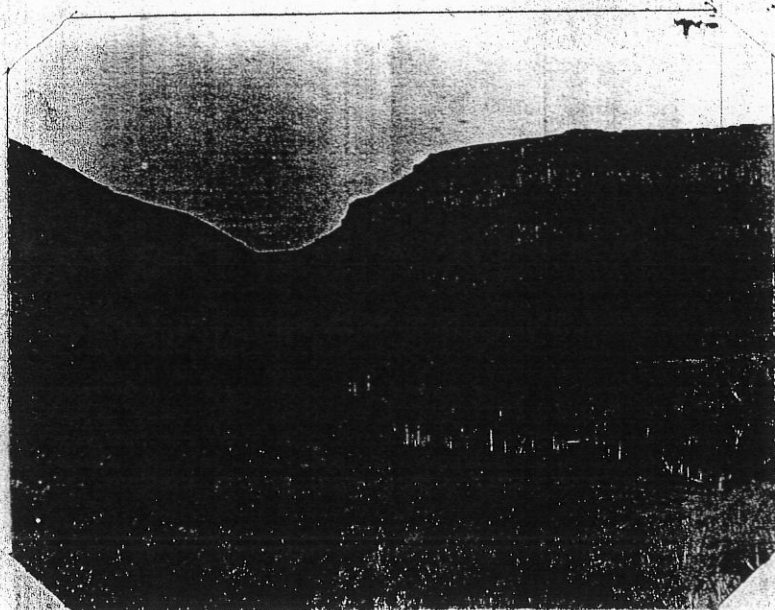


Good Grass on the
Granite Belt. Lower
Coon Creek.

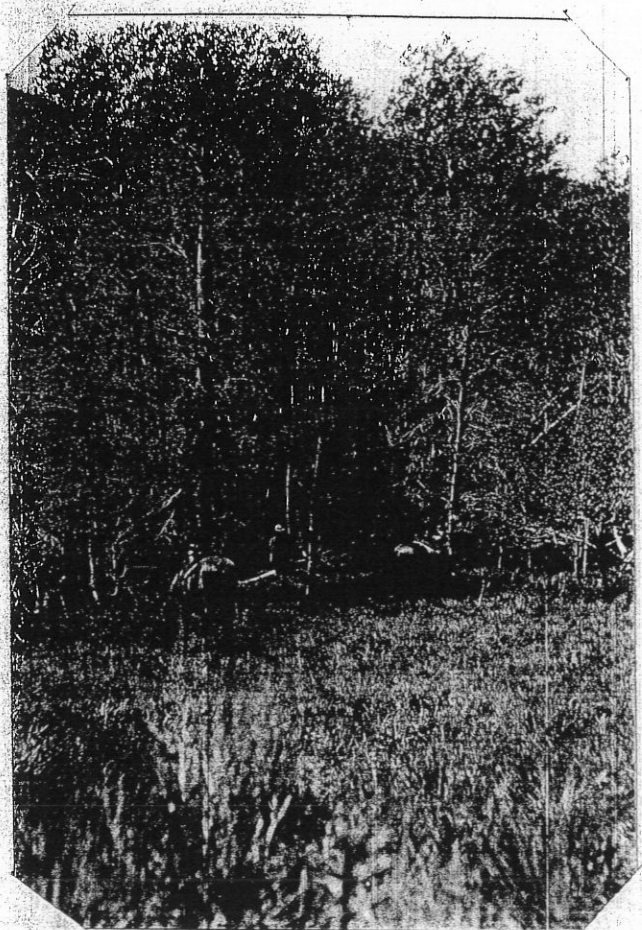
Aspen brush and
Ceanothus about a
snow drift. Diamond
A Desert. Photo by
Geo. C. Thompson.



3



The aspen type
follows the streams
through the grass and
sage land. Robinson's
Hole.



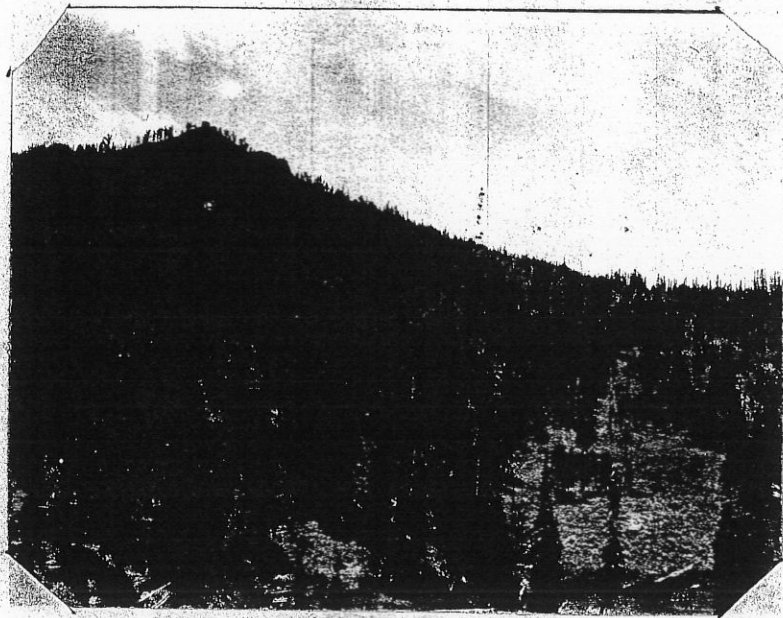
Dense Aspen pole stand.
Tennessee Creek Basin.
Photo by Geo. C. Thompson.



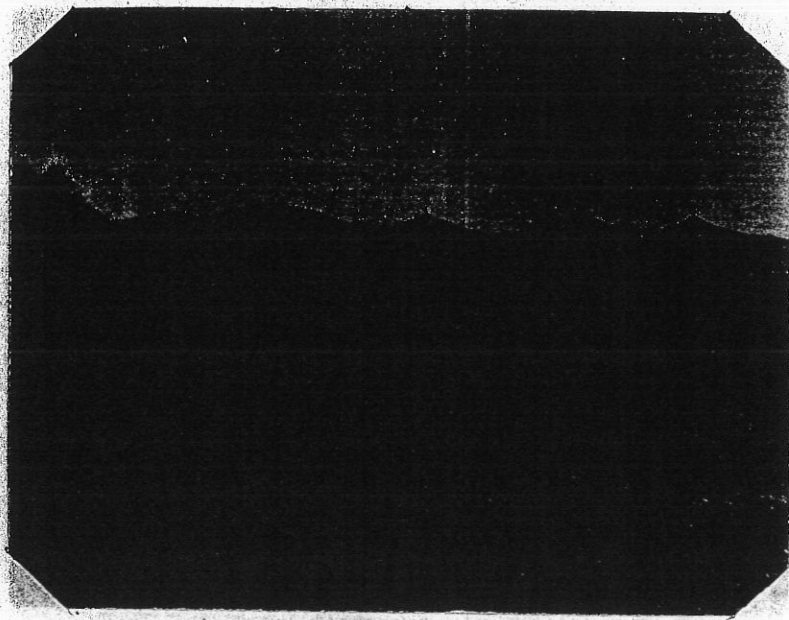
Dense Alpine sub-
type. White-bark pine
predominating. The lit-
tle trees in the fore-
ground are alpine firs.
Howard Timber.

Open Alpine sub-
type. "The Old Or-
chard." Howard tim-
ber. Photo by Geo.
C. Thompson.



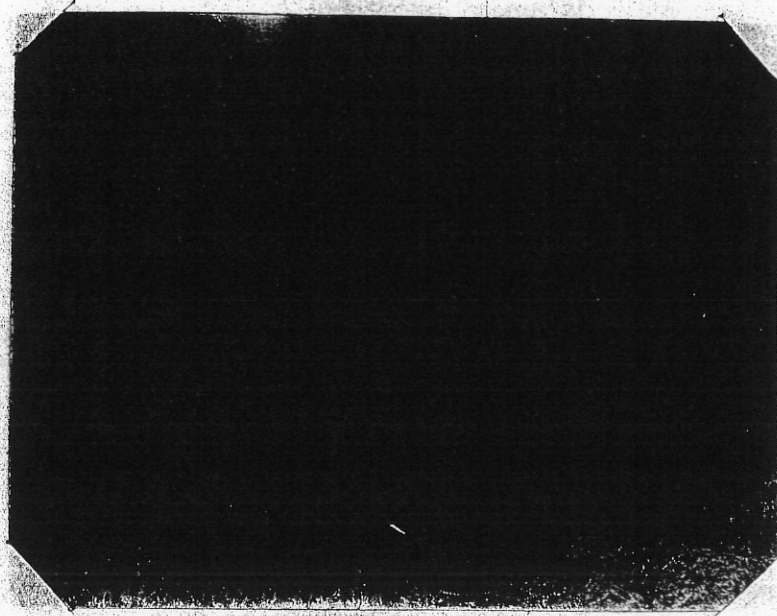


Fir predominates in the Bear Creek timber.

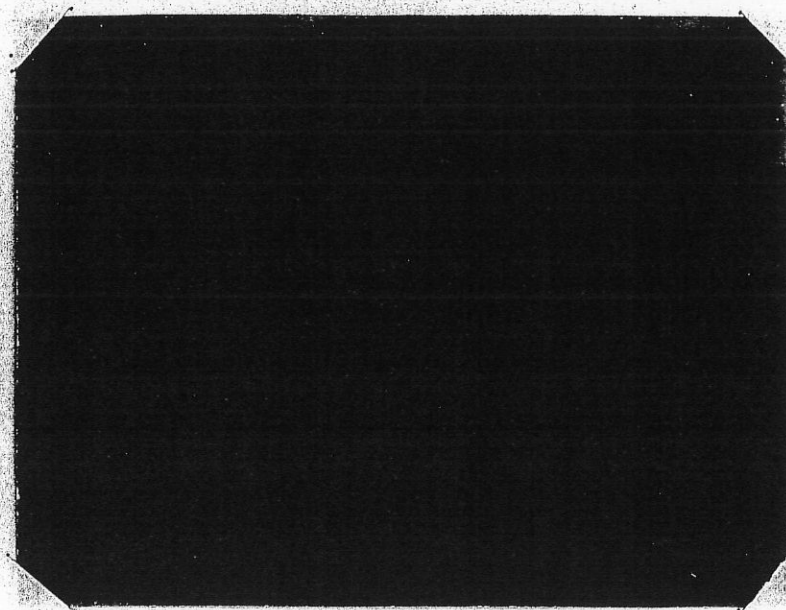


A good patch of timber on Bear Creek. The Jarbidge Mountains are in the distance.

6



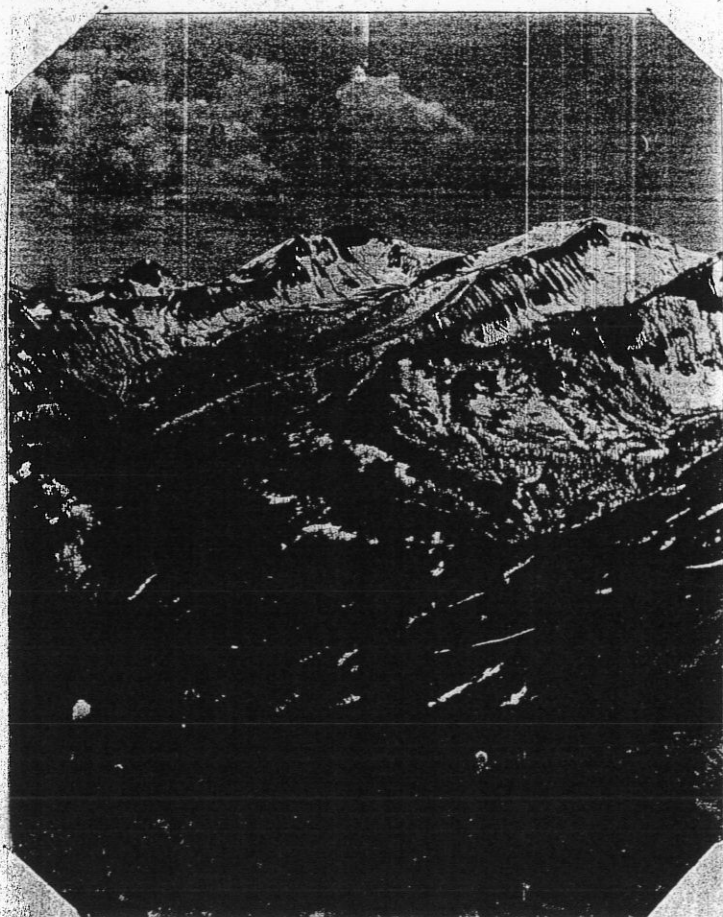
Open Alpine sub-type. Head of Pine Creek. Copper Mountain in distance.



In the distance - Jarbidge Mountains with the Open Alpine Sub-type. In the foreground - the Dense Sub-type on the head of Fox Creek.



Edge of the Dense
Alpine Sub-type. Edge-
Mont. Photo By Geo. C.
Thompson.



Three of the
Jarbidge Peaks, from
the North-East, and a
part of East Fork Basin.
Photo by Geo. C. Thomp-
son.

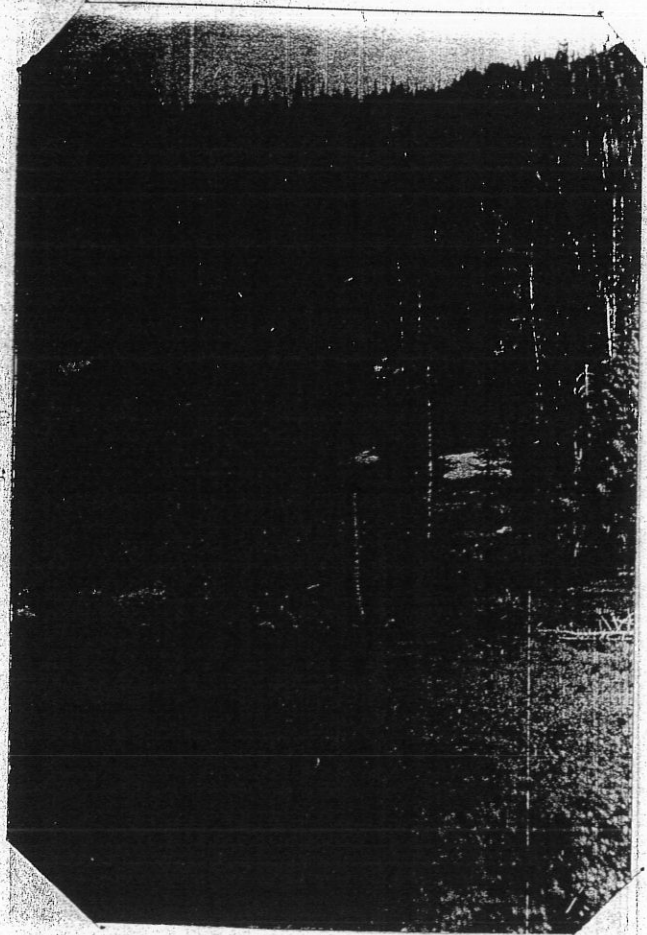


White Bark Pine.

The central trees
have been killed by
Dendroctonus monti-
colae. The large trees
are between 14 and 18
inches in diameter.
Head of Bear Creek.

The best of the Bear Creek
Creek timber - Chiefly Alpine
Alpine Fir.

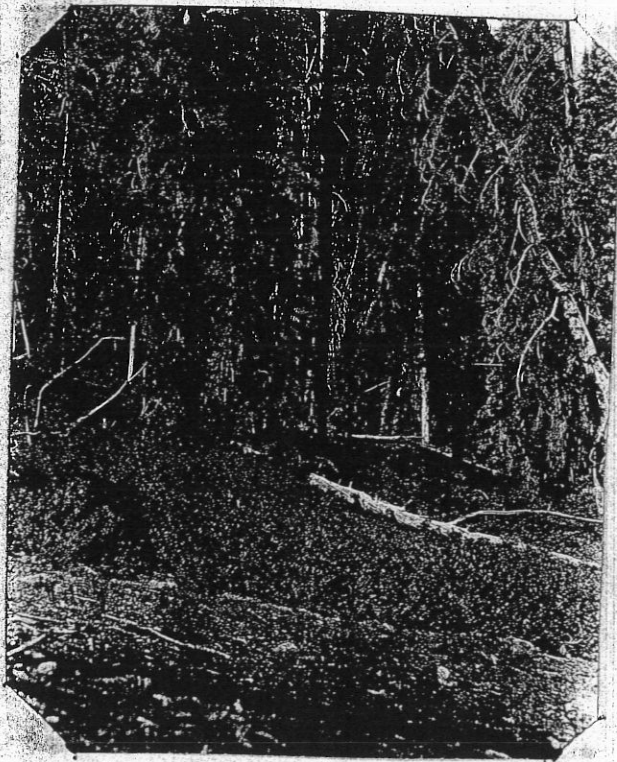
Photo by Geo. C.
Thompson.

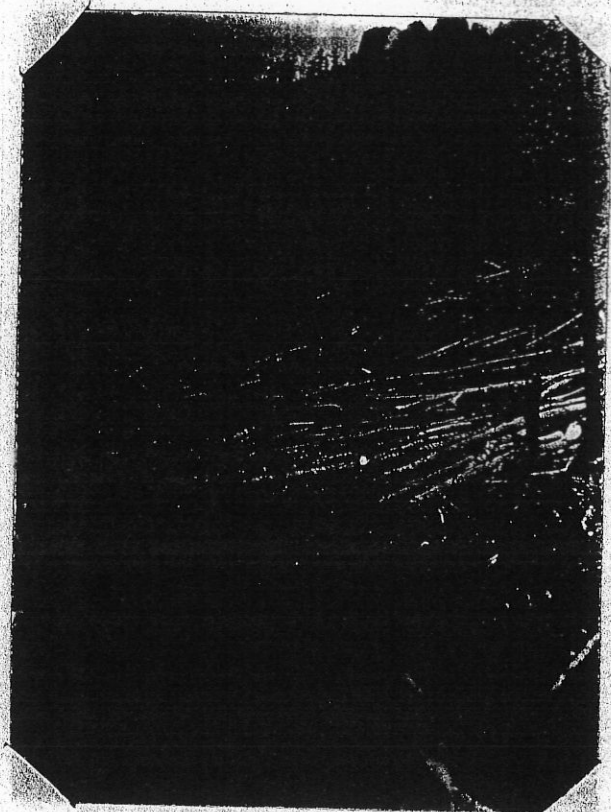




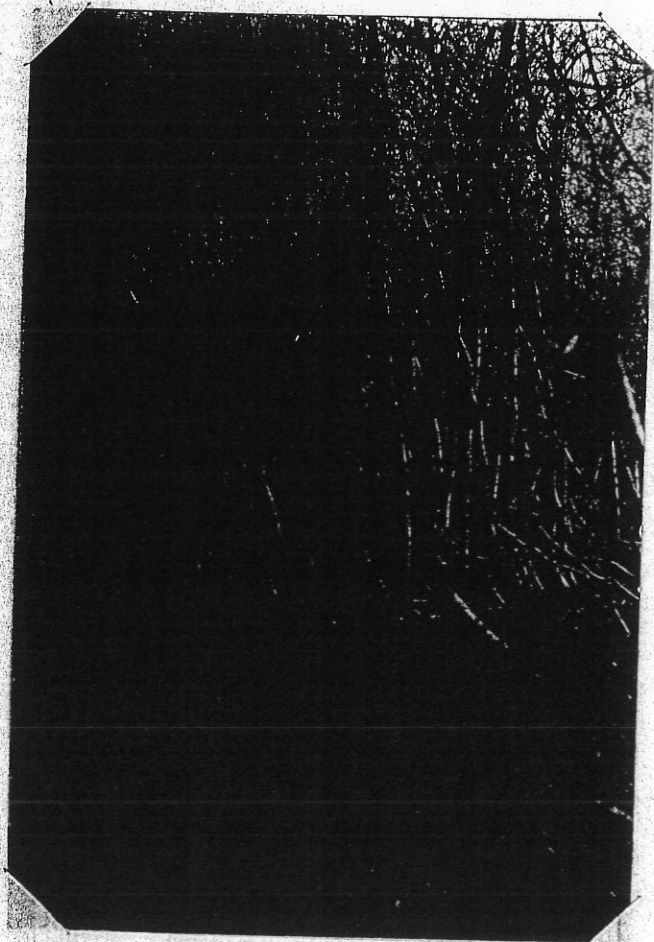
This white-bark Pine
stump marks the corner of
a mining claim that was
staked out in mid-winter.
Between the trees the
ground is almost bare.
Howard Timber.

Ceanothus often
occurs on the edges
of the alpine type.
Dead trees are com-
mon throughout the
type. Head of Jar-
bidge River.

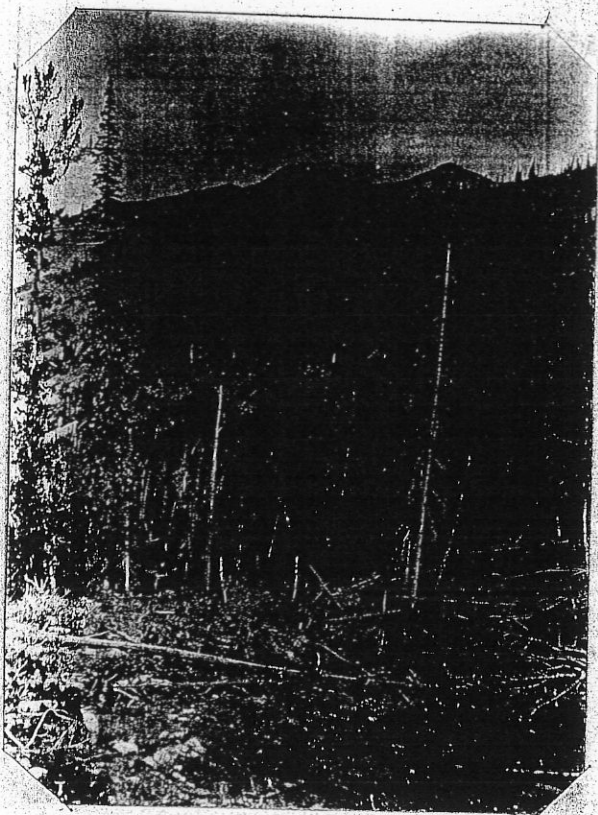




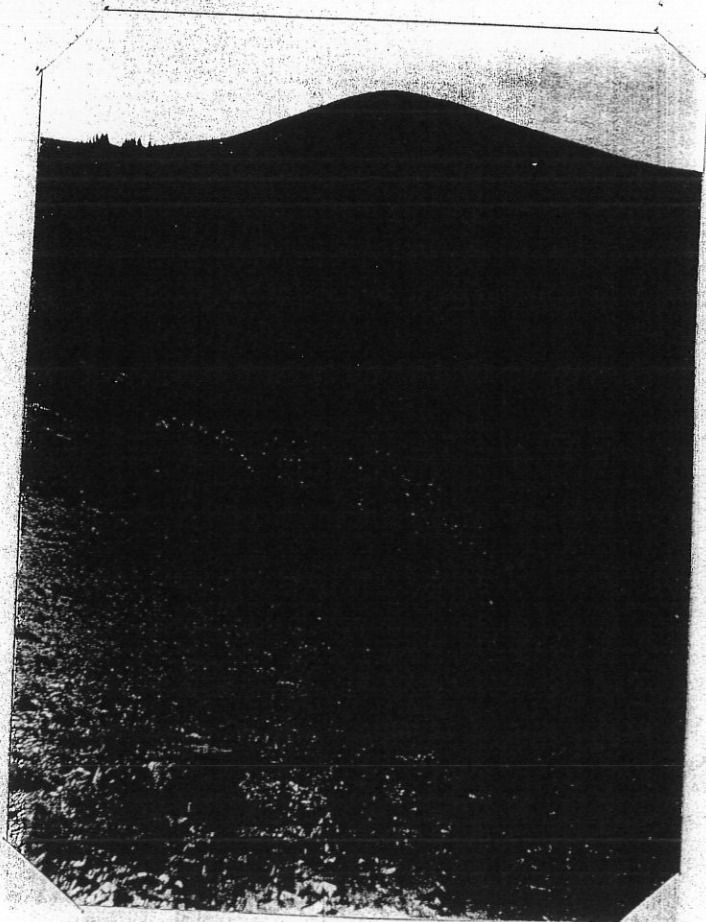
Debris from a Short-
lived Slide on Fox
Creek. - - -



Upland aspen showing
deformation by snow.
Photo by Geo. C. Thomp-
son.



A slide-swept area
in the dense alpine
sub-type. Head of Fox
Creek.

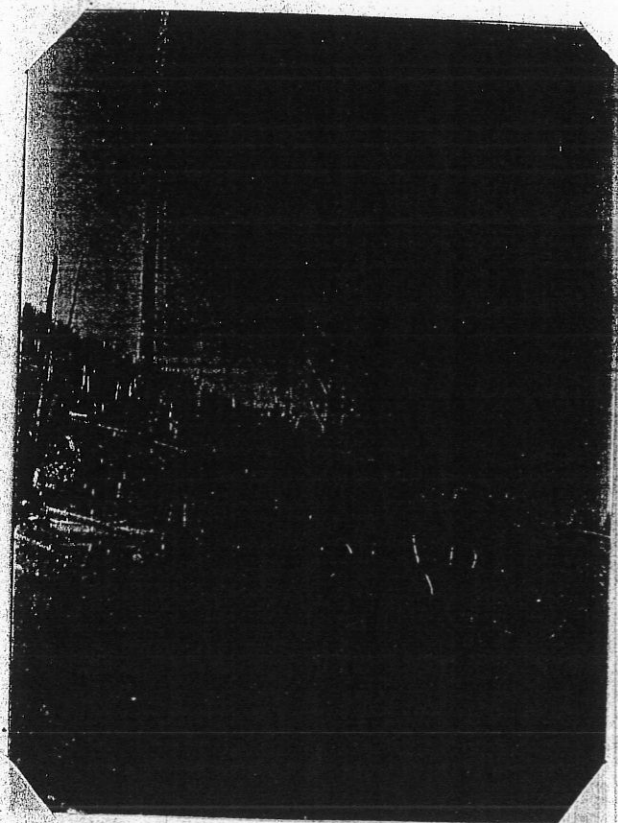


The Merritt Moun-
tain Slide. Photo by
Geo. C. Thompson.

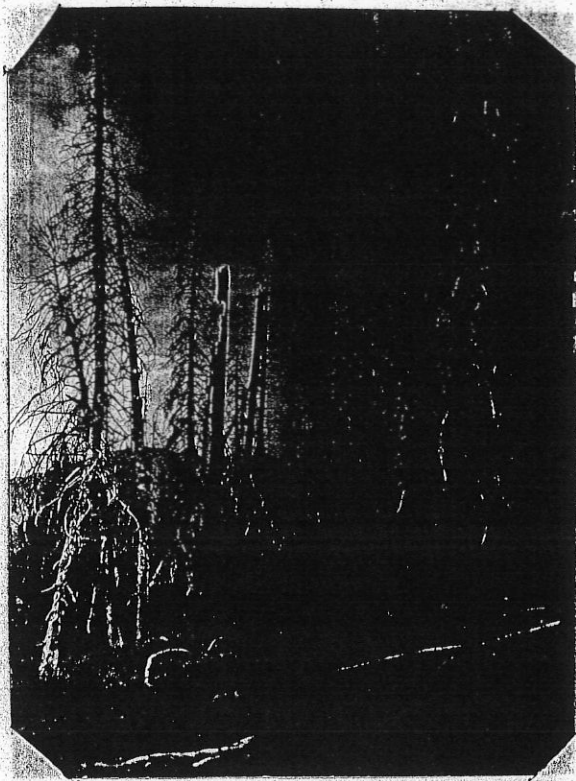


Fir reproduction is usually present in greater abundance than pine in the paths of snow slides. There are numerous pines just above the site of the picture. Fox Creek.

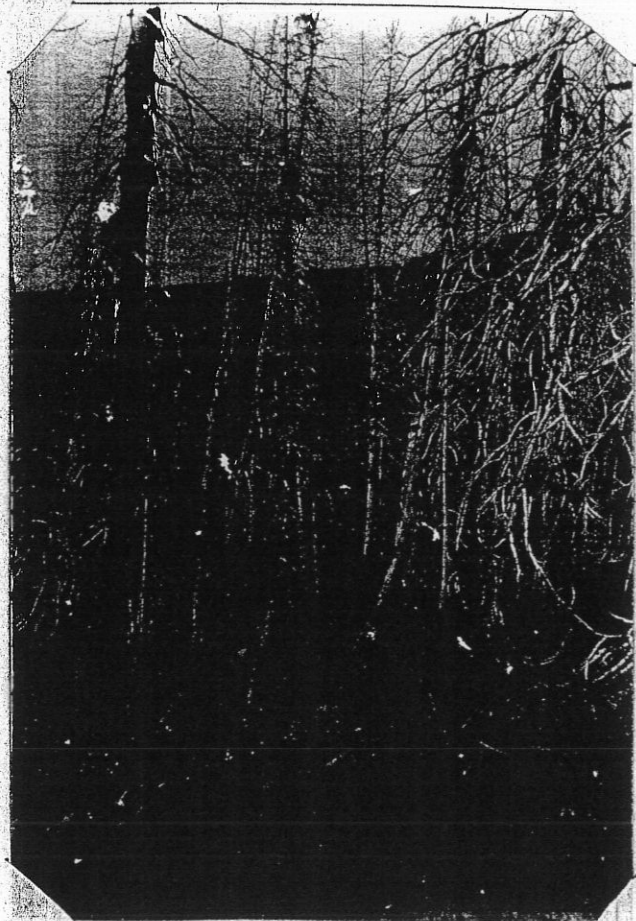
A Contrast in Form.
Alpine Fir and limber
pine stubs in the burn
above Howard's Cabin.



13

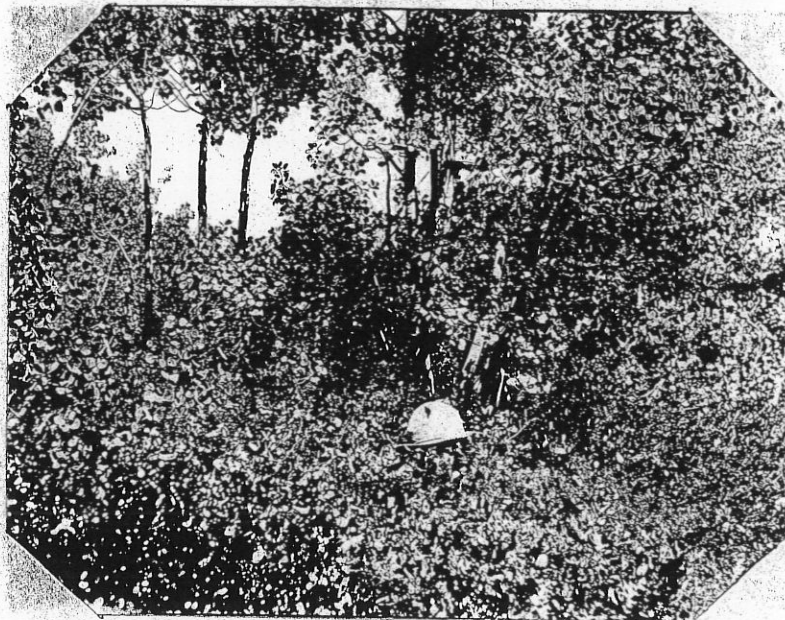


Alpine fir is very
easily killed by fire.
Head of Coon Creek.

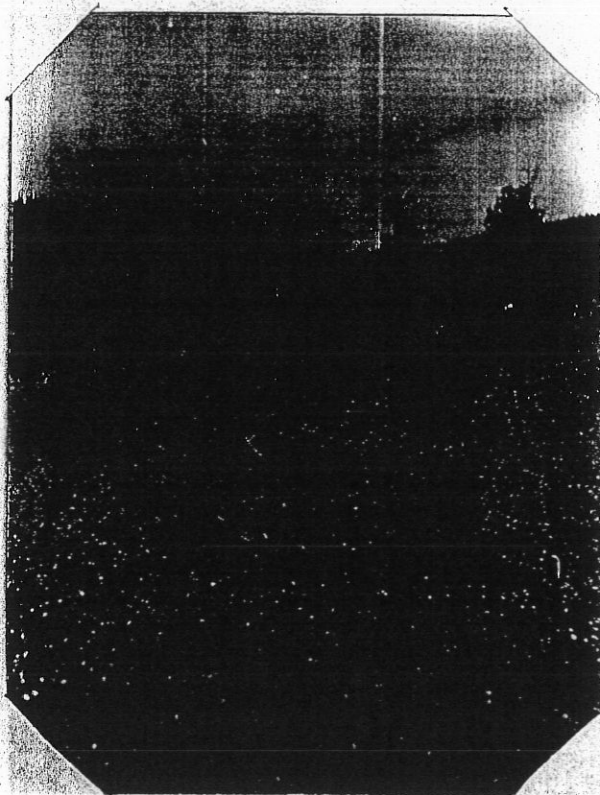


The Old Burn on
Bear Creek.
Photo by Geo. C.
Thompson.

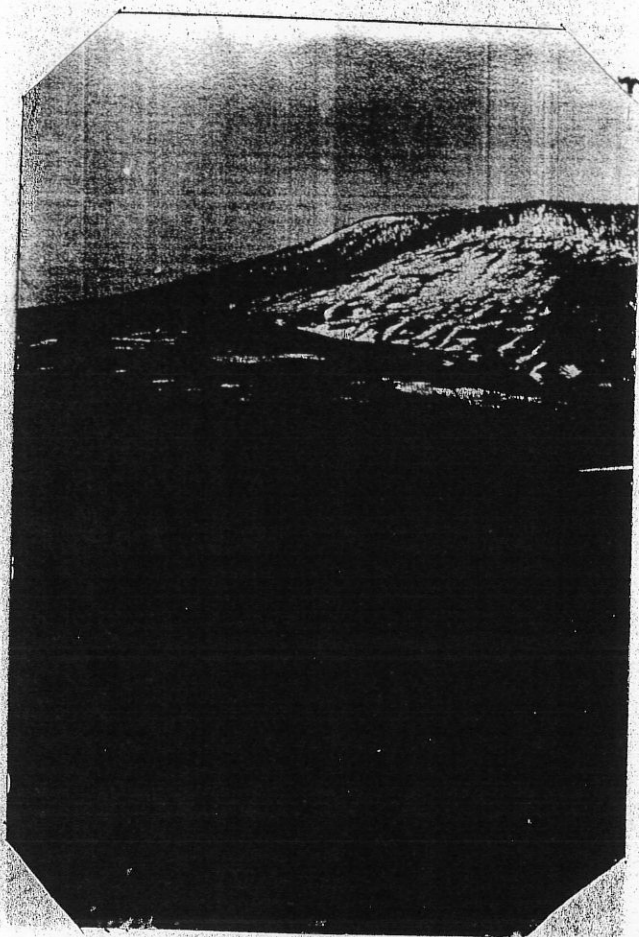
14



Aspen pushes up through ceonothus with ease.
Wilkins' Fork Basin.



Alpine fir and limber pine are both able to suppress
the ceonothus "chapparral" which frequently follows burns
in the alpine type. Wilkins' Fork Basin.



The fir is slowly
regaining possession of
the old burn above Howard's
Cabin. The mottled patches
(lower picture) are
ceonothus. Photo^s by
Geo. C. Thompson.

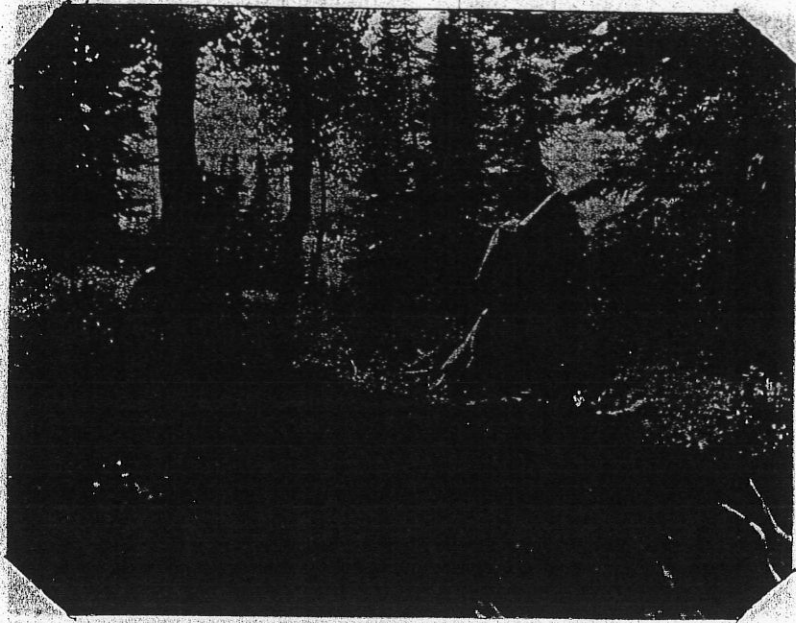




Dendroctonus mont-
icolae has killed these
unusual limber and white-
bark pine poles on the
Deer Creek Summit.

The same insect has
killed most of the pines
left after the New York-
Nevada Gold Mining Com-
pany's trespass cutting
on Copper Mountain.

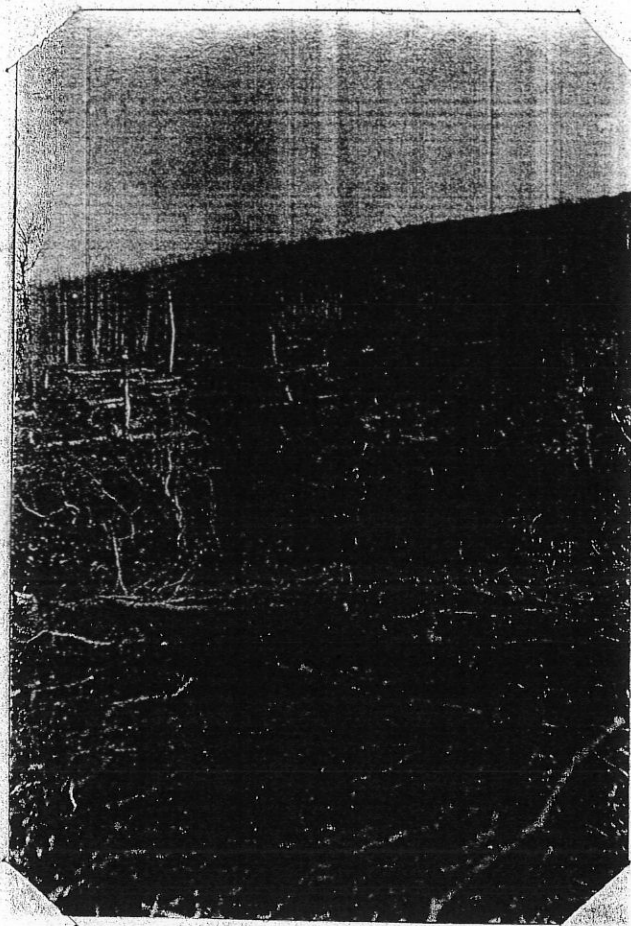




On the Outskirts of the Alpine Type. Coon Creek,



The aspen type suffers considerable injury from snow drifts. Sheep counting chutes become dusty very quickly. Poison Creek.

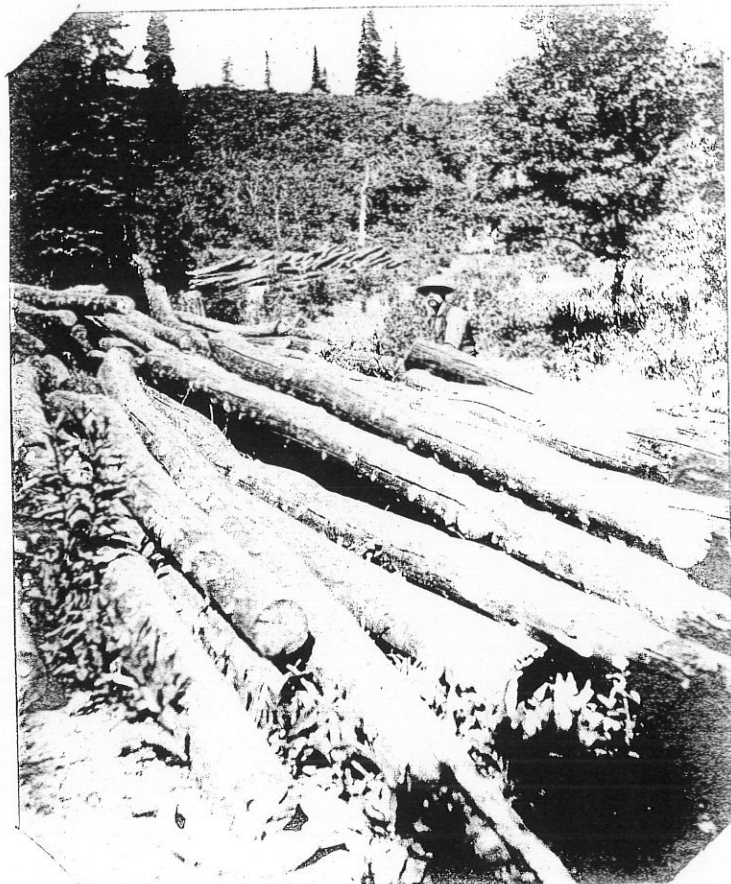


Slashed and over-
grazed Aspen.

Photo by Geo. C.
Thompson.
Tennessee Creek.



Slash from an Old Cutting
Cutting in the Alpine Type.
This brush has been
piled. Van Duzer Creek.
Photo by Geo. C.
Thompson.



Fir Mining Timbers. Brushy Aspen Beyond.
material.
From an old trespass [^] now removed. Van Duzer Creek.

Photo by Geo. C. Thompson.